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Sport Fishery Abstracts

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Sport Fishery Abstracts

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Sport Fishery Abstracts is intended to furnish fishery biologists in government agencies and educational institutions with abstracts of the current literature in sport fishery research and management. Abstracts of papers on limnology, ecology, natural history and other fields of specialization will be included when the subject has application to the conservation of sport fish and the restoration of sport fishing.

Initials following an abstract are those of abstractors whose names are listed on the last page. Those abstracts without a source indicated were prepared by the Editorial staff. One volume consisting of not more than four numbers will be issued each year. Each number contains separate Author and Subject indexes, with the final number of each volume containing cumulative indexes.

The last number of each volume contains a list of publications screened for appropriate material. Suggestions for improving the usefulness and coverage of Sport Fishery Abstracts are solicited.

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Prepared in the Branch of Federal Aid
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1083. Beach, Neil William. 1957. A STUDY OF THE PLANKTONIC ROTIFERS OF THE OCQUEOC RIVER SYSTEM, PRESQUE ISLE COUNTY, MICHIGAN. Dissertation Abstr., Vol. 17, No. 6, pp. 1416-1417.

The objectives of this study were: (1) determination of the identity of any planktonic rotifers occurring anywhere within the Ocqueoc River system; (2) comparison of the qualitative and quantitative aspects of the separate rotifer faunas in each of the discrete lotic and lentic habitats of the system; (3) analysis of the differential effects of stream and impoundment conditions, natural or otherwise, on both autochthonous and allochthonous rotiferan faunas; and (4) determination of those factors, whether physical, chemical, biological or any combination thereof, which in any significant degree might be responsible for the development and maintenance of any autochthonous rotiferan fauna anywhere in the system.

Field work included collecting and preserving a total of 534 plankton samples. Live samples were also taken for more accurate identification of the organisms. Collections were made in all seasons of the year, but mostly in the summer, and taken at 42 field stations, of which 23 were located in the river proper and the remainder in lakes. Most of the preserved samples were quantitative in nature and usually from surface waters. They were obtained by straining a given volume of water, collected with a Kemmerer water sampler, through a Wisconsin plankton net equipped with No. 25 silk bolting cloth. Duplicate samples were taken at each station. Selected physicochemical data were obtained at the same time the plankton was collected. The samples were examined microscopically and all rotifers contained in an entire Sedgwick-Rafter counting chamber were enumerated. Two chamberfulls were counted for each sample bottle and final calculations of the population at any given station are based on an average of two such duplicate counts.

Twenty-four genera containing 34 species of rotifers were identified in the plankton, most of which have also been reported from other lakes and rivers. Lakes and artificial impoundments were the major locations of plankton production in the system and supplied the river with its "limnetic" rotifers. Lotic situations did not possess a planktonic rotifer fauna distinct from lakes and any rotifers collected in the river were also collected in lakes. As the water flowed downstream from a lake, the plankton decreased and eventually disappeared if the length of the stream segment was great enough. Additional factors effecting a decrease were current, depth of water, turbulence, and amount of vegetation, or other objects, in the channel which supported a periphyton assemblage. The periphyton acted as a filter and strained the organisms from the flowing water. As a result, little plankton from one lake was transported to another. The rotifer fauna varied somewhat from lake to lake but such variation was more quantitative than qualitative in nature. Males of Keratella cochlearis were found in one lake in all summer collections and their presence shown to be related to abundance and quality of food material and to conditions of crowding rather than to temperature. Males were also obtained in autumn samples from other lakes. Considerable numbers of Limnias ceratophylli were collected in the open water of a few lakes although this species is usually considered to be sessile.

It is concluded from this study that the Ocqueoc River system does not differ significantly in the quality of its planktonic rotifer fauna but rather in the quantity and proportion of its abundant forms. The system is classed as a Keratella-Polyarthra-Synchaeta complex and Keratella cochlearis is the dominant species, both in abundance and distribution. (Auth. abst.)

1084. Forney, John Latimer. 1957. PROPAGATION OF BAIT FISHES IN NEW YORK FARM PONDS. Dissertation Abstr., Vol. 17, No. 6, p. 1420.

Bait fish were stocked in 72 farm ponds located in central New York State during 1953-54. Seven species were tested individually in one or more ponds. Three species, the golden shiner, white sucker and fathead minnow, are recommended for propagation in New York ponds.

Adult golden shiners were stocked in ponds at rates of 200 to 1,800 per acre. Population estimates during the second growing season demonstrated that the number of golden shiners present was governed more by physical and biological environment than by stocking rate. The weight of the standing crop in 11 ponds at the end of the first growing season averaged 167 pounds per acre compared to 375 pounds per acre in August of the second growing season.

Suckers were stocked as advanced fry in 13 ponds at rates of 50,000 to 231,000 per acre. Survival of fry to fall ranged from 1 to 71 percent and averaged 21 percent. The rate of growth in fertilized ponds was negatively correlated with the population density. The yield during the first growing season averaged 265 pounds per acre. In six ponds where young were over-wintered, the mean length increment was 0.72 inches and the population weight increased 92 pounds per acre.

Adult fathead minnows were stocked in 8 fertilized ponds at rates of 600 to 2,000 per acre. A relatively small proportion of the first year's hatch of young reached saleable size of 1.8 inches by fall, and the average yield from eight ponds was 12,140 per acre. These ponds yielded 31,000 to 62,000 saleable-size fathead per acre during the second growing season.

Methods are described for managing New York bait fish ponds. (Auth. abst.)

1085. Taylor, William Ralph. 1957. A REVISION OF THE GENUS NOTURUS RAFINESQUE WITH A CONTRIBUTION TO THE CLASSIFICATION OF THE NORTH AMERICAN CATFISHES. Dissertation Abstr., Vol. 17, No. 1, p. 192.

The purposes of this study are to determine the phylogeny of the North American catfishes, family Ictaluridae (formerly Ameiuridae), and to analyze the species of Noturus and Schilbeodes, here

grouped as the genus Noturus Rafinesque.

In order to interpret their relationships, an investigation was made of the external morphology and osteology of the fishes assigned to the Ictaluridae. The recognized species constitutes six genera which form three major natural groups. Each encompasses one monotypic genus that is blind, unpigmented, and of restricted subterranean range and one genus with species that are eyed, pigmented, and of widespread occurrence in surface waters. The divisions are: (1) an Ictalurus group including the genus Ictalurus Rafinesque and, provisionally, Trogloglanis pattersoni Eigenmann, (2) a Noturus group containing that genus and Prietella phreatophila Carranza, and (3) a Pylodictis group consisting of Pylodictis olivaris (Rafinesque) and Satan eurystomus Hubbs and Bailey. The morphology of the genera is discussed and treated comparatively. It appears that the phylogenetic groups of the Ictaluridae stem from a common ancestor in North America, probably in the early Tertiary.

An examination was made of most of the available museum specimens of madtoms and stonecats, genus Noturus. These were determined to represent 20 species. They are described and illustrated and their ranges are defined and mapped on the basis both of the specimens examined and a review of the literature. Variational data, which form the background for the description of each species, are presented; the data were taken from random samples of specimens collected throughout the range of each species. Some variations, such as in number of caudal rays of Noturus gyrinus, are found to form geographic gradients or clines; others, for example the degree of pigmentation and fin-ray counts in Noturus exilis, form an irregular geographic pattern. Some species, e.g. Noturus miurus, show relatively high constantancy, over a wide area. Notes on the ecological relationsips of each species are given. Observations were made on the life history of Noturus miurus and Noturus stigmosus, and the structure of the young of Noturus miurus is discussed. Three hybrid individuals of two interspecific crosses are described and are compared with their parental species.

The nominal genera Schilbeodes Bleeker, Pimelodon Vaillant, Noturus Rafinesque, and Rabida Jordan and Evermann are regarded as acceptable subgeneric divisions of the genus Noturus. Two of these are monotypic: Schildbeodes represented by Noturus gyrinus (Mitchill), and Noturus by Noturus flavus Rafinesque. The subgenus Pimelodon contains Noturus leptacanthus Jordan, Noturus nocturnus Jordan and Gilbert, Noturus insignis (Richardson), Noturus funebris Gilbert and Swain, Noturus exilis Nelson, and Noturus gilberti Jordan and Evermann. The subgenus Rabida includes Noturus hildebrandi (Bailey and Taylor), Noturus eleutherus Jordan, Noturus furiosus Jordan and Meek, and Noturus miurus Jordan in addition to eight species which are described as new. The natural relationship of the species of Noturus and the evolution of their characters are discussed. (Auth. abst.)

1086. Phillips, Arthur M., Jr. and George C. Balzer, Jr. 1957. THE NUTRITION OF TROUT: V. INGREDIENTS FOR TROUT DIETS. Prog. Fish-Cult., Vol. 19, No. 4, pp. 158-167.

A general review of the factors upon which animal diets are based, including tables of food analyses and tables of suggested diet formulae for trout hatcheries. Methods for experimental testing of new diets in producing trout hatcheries are described. (Auth. abst.)

1087. Jeppson, Paul. 1957. THE CONTROL OF SQUAWFISH BY USE OF DYNAMITE, SPOT TREATMENT, AND REDUCTION OF LAKE LEVELS. Prog. Fish-Cult., Vol. 19, No. 4, pp. 168-171.

Observations of the Columbia River squawfish, Ptychocheilus oregonensis (Richardson), in northern Idaho lakes indicate that numbers can be controlled by dynamiting of spawning schools, drawdown of lake levels to destroy spawn, and treatment of spawning sites with fish eradicants to kill fry. Spawning was observed over coarse, wave-washed rubble bottom at depths of less than one foot. The period of spawning extended from mid-June to mid-July in water temperatures ranging from 58° to 68° F.; the period of incubation was 7 to 8 days. Food habits, spawning, age, maturity, and growth are discussed. (Auth abst.)

1088. Nemoto, Carl M. 1957. EXPERIMENTS WITH METHODS FOR AIR TRANSPORT OF LIVE FISH. Prog. Fish-Cult., Vol. 19, No. 4, pp. 147-157.

Fish were held in sealed containers, usually plastic bags, under a variety of experimental treatments. These included replacement of air in the bag by oxygen; the use of bone charcoal and dibasic sodium phosphate as a buffer against pH changes arising through the discharge of metabolic wastes; the addition of sodium amytal to reduce metabolic rates of the fish; and the use of urease, permutit, and ion-exchange resins to eliminate certain metabolic products. A technique using a plastic bag that contained 75 percent oxygen and 25 percent water, fish (1 g. or less to 13 cc. of water), and other constituents was recommended. Sodium amytal (1 grain to 4 liters of water) and bone charcoal (1 lb. to 4 liters of water) were suggested as additions to be used after testing with each species shipped. (Auth. abst.)

1089. Lennon, Robert E. 1957. OBSERVATIONS ON WILD, LONG-JAW RAINBOW TROUT. Prog. Fish-Cult., Vol. 19, No. 4, pp. 179-181.

Collections of wild rainbow trout from the West Prong, Little Pigeon River, Great Smoky Mountains National Park, during the past 4 years have included specimens with markedly elongated lower jaws. The condition occurred on mature and immature fish of both sexes which were 3.4 to 11.5 inches long and 0 to 3 years old. Comparative measurements on these and normal rainbow trout disclosed that the mandibles of long-jaw fish were generally over-sized laterally and longitudinally rather than elongated at the tip. In addition, the snouts of long-jaw specimens were slightly longer

than those of normal fish. There were no significant differences in the coefficients of condition in the two groups of trout. The cause of the long-jaw condition was not determined; but as no such specimens were taken in extensive collections in nearby streams, the anomaly may be congenital or the result of a disease peculiar to rainbow trout in the West Prong. (Auth. abst.)

1090. J. Rukavina and D. Varenika. 1956. AIR BUBBLE DISEASE OF TROUT AT THE SOURCE OF THE RIVER BOSNA. (Mjehuričavost Pastrva na Vrelu Bosne). Acta Ichthyologica Bosniae et Hercegovinae, Editium 1. X., No. 7.

The author has described the case of mass disease and death of trout in the ponds at the source of the River Bosna. The disease occurred in late June and early in August 1956, a period of extreme heat, and intensive insolation. The fish usually start dying early in the afternoon. They first show signs of agitation, swim aimlessly near the surface, then are quiet for a time, then become lethargic and die. At the very beginning of the disease one can notice air bubbles ranging from the size of a pin's head to a hazelnut all over the fins, the tail, the opercula on the inner and outer sides, in the mouth, joints, and in the eye itself. Air bubbles are found in dead fish, and the ill ones that have been caught, not only on the surface of the body, but also in the internal organs such as: the pharynx, gill-fillaments and brachial arches, below the intestine serose and on the abdominal wall, in the heart, along the blood vessels, and in the muscles. In some dead fish blood spots are found in the mouth, the pharynx and on the brain membrane.

In the author's opinion the appearance of the air bubbles in the body of the fish at the source of the River Bosna is due to frequent and sudden changes in the total gas pressure in the water. The particularly inconvenient position of the pond, several hot days in succession, and the irregular run, in the middle of the pond, of the spring water, which is poor in oxygen, and dense plant association covering a large part of the pond added to the effect of this.

When the fish were taken to another pond with regular inflow of the water, with sparser plant associations and more constant temperature the disease and death of fish stopped.

Excellent photographs given by the author. (From auth. summ.)

1091. Brown, Jerram L. 1956. DISTINGUISHING CHARACTERS OF THE CYPRINODONT FISHES, FUNDULUS CINGULATUS AND FUNDULUS CHRYSOTUS. Copeia, No. 4, Dec. 31, pp. 251-255.

An adequate differentiation in a key or guide to identification of Fundulus chrysotus and F. cingulatus has not been made. To correct this deficiency, this study analyzes the variation in the main characters of these two small topminnows of the lowland swamps of southeastern United States.

1092. Dineen, Clarence F. and Paul S. Stokely. 1956. THE OSTEOLOGY OF THE SACRAMENTO PERCH, ARCHOPLITES INTERRUPTUS (GIRARD). Copeia No. 4, Dec. 31, pp. 217-230.

A complete description with drawings of the osteology of the Sacramento perch is presented. This study is based on 14 specimens ranging in total length from 61 to 240 mm.

1093. Mansueti, Romeo. 1956. RECAPTURES OF TAGGED STRIPED BASS, ROCCUS SAXATILIS (WALBAUM), CAUGHT IN DEEP WATER OF CHESAPEAKE BAY, MARYLAND. Md. Dept. of Res. and Edu., Chesapeake Biol. Lab., Resource Study Rep. No. 10, Oct., 9 pp.

Preliminary tagging studies of striped bass with over-inflated swimbladders due to rapid ascent and pressure decreases, demonstrated survival based on recaptures following marking. The fish were tagged from drift gill nets that fished populations overwintering at depths of 80-120 feet and at temperatures just above freezing in the channel of Chesapeake Bay, off Calvert County, Maryland, during February 1954. Of the total of 31 striped bass marked with Petersen disk tags, 11 tags were returned by fishermen within three months at 11 scattered localities in Chesapeake Bay. The movements, based on the recaptures, indicated that there was apparently a random dispersal from the tagging source. A substantial portion of the tagged sample apparently recovered from the distress of over-inflated swimbladders, at least to migrate to various parts of the Bay. Various attributes of the vital statistics of the fish were studied, and the results are embodied in the report. The study revealed for the first time that striped bass can be brought up rapidly from depths that are subject to three or four atmospheres (as much as 3,000 mm. Hg.), tagged, released, and recaptured. (Auth. abst.)

1094. Fisher, A. 1956. THE EFFECT OF COPPER SULPHATE ON SOME MICRO-ORGANISMS IN FISH PONDS. Bamidgeh, Vol. 8, No. 3, July. pp. 39-43.

The effect of copper sulphate on Daphnia, Cyclops, and Chironomidae was tested at various concentrations, at various temperatures, in distilled, tap and pond water with and without soil. Daphnia were found to be most sensitive, followed by Chironomidae, and then Cyclops.

The higher the concentration of copper sulphate and the higher the temperature, the more toxic the solution. Equal concentrations differed in toxicity depending on water source, the most toxic being distilled water, then tap water and pond water. The higher the pH the lower the toxicity of copper sulphate. The addition of soil to pond water lowered the pH thereby increasing the toxicity of the solution. It seems the main copper retention is in water, the soil being able to retain only a very small amount.

1095. Cooper, Luther Bancroft and Andrew Frederick Hemphill. 1957. RECORDS OF THE LAMPREY LAMPETRA AEPYPTERA FROM ALABAMA. Copeia, No. 1, April 5, p. 54.

Records are given of Alabama collections of

Lampetra aepyptera, which has previously been reported only from the Alabama River system near Rome, Georgia, and the Tombigbee and Pascogoula drainages, Mississippi.

1096. Daiber, Franklin C. 1956. A COMPARATIVE ANALYSIS OF THE WINTER FEEDING HABITS OF TWO BENTHIC STREAM FISHES. Copeia, No. 3, Aug. 29, pp. 141-151.

A food habit study was conducted on 240 barred fantail darters, Etheostoma f. flabellare, and 307 northern mottled sculpins, Cottus b. bairdi. The fish were collected from a small headwater stream in Allegany County, New York, from October 12, 1951 to May 9, 1952.

There is great qualitative similarity in the food habits of both fishes. However, there is a shift in importance for the various food items among different size groups within the same species and between the two species. The qualitative similarity in food habits might suggest competition. If competition for food exists between these two fishes, it is kept at a low level by the low metabolic demands of both species during the period studied. Differences in feeding behavior, availability, and the exercise of selectivity for certain food items also tend to reduce competition. (Auth. summ.)

1097. Lander, Robert H. 1956. SEQUENTIAL ANALYSIS IN FISHERY RESEARCH. Copeia, No. 3, Aug. 29., pp. 151-154.

Sequential analysis is essentially a procedure which leads to a decision without fixing the sample size in advance. The probabilities associated with the particular order of occurrence of the items so far observed are used to formulate rules which result in a reduction in the average sample number required for a decision. The basic theory and certain applications to the field of industrial acceptance sampling have been developed by Wald and his associates (Statistical Research Group, Columbia University, 1945; Wald. 1947). These workers were well aware of the possibilities of the method in experimental work.

A hypothetical application is treated to outline the essential elements of the method.

1098. Brock, Vernon Eugene and Michio Takata. 1955. CONTRIBUTION TO THE PROBLEMS OF BAIT FISH CAPTURE AND MORTALITY TOGETHER WITH EXPERIMENTS IN THE USE OF TILAPIA AS LIVE BAIT. Final Rep., IRAC Grant No. 49, Div. of Fish and Game, Bd. of Commissioners of Agric. and Forestry, Hawaii, Jan., 39 pp.

The objectives of these investigations, conducted from November 1953 to October 1954, were threefold: (1) to develop improved methods of holding bait fishes, (2) to develop improved methods of capturing bait species, and (3) to test the suitability of Tilapia mossambica, as live bait for tuna fishing.

If injuries sustained during netting and transfer to the bait well caused a loss of body fluids through osmosis to the hypertonic sea-water medium, reduction in salinity should prevent the loss of body fluids and thereby reduce mortality. A 50 percent reduction in salinity of the medium resulted in a reduction of mortality of 66 to 87 percent. Additional studies of bait fish mortalities indicated a highly significant association between size of fish and time to death with the small fish dying before the large fish.

An experimental night bait lift net which is essentially a rectangular box of netting with a floor and four collapsible walls which guide on weighted corner lines by means of brass rings was developed, and repeated tests proved it to be a highly efficient gear.

Young of Tilapia mossambica, one to three inches in length, were reared in fresh water and acclimatized to salt water over a period of three days. Conclusive evidence was obtained, which indicates that they are acceptable to the tuna being used successfully as chum and on baited hooks. Their extreme hardiness and the ease with which they can be kept in captivity makes it possible, with feeding, to hold them for a long period in the bait well of a tuna boat. These and other attributes possessed by this remarkable fish indicate that it may prove to be a valuable supplementary bait fish. (From auth. summ.)

1099. Eaton, Theodore H. 1956. NOTES ON THE OLFACTORY ORGANS IN CENTRARCHIDAE. Copeia, No. 3, Aug. 29, pp. 196-199.

In Centrarchidae there are two accessory pouches opening from the posterior part of the primary nasal sac that act as water pumps during the protractile and retractile movements of the upper jaw. The olfactory epithelium, supplied by branches of the olfactory nerve, is thrown into a series of folds (except in very small individuals) radiating mediad, laterad and caudad from a central ridge. In development the most posterior fold appears first, followed by those above (mediad) and below (laterad) the ridge progressing anteriorly together. In general, the number attained depends upon the size of the fish. In Archoplites, Pomoxis and Centrarchus the folds are paired; alternate ones are swollen. In other sunfishes this pairing has not been found, and either the more posterior, or all, of the folds may be swollen. Mesogonistius and Enneacanthus show reduction of the number of folds (by failure to develop the more anterior), and in Elassoma only three rudimentary folds, and the central ridge, may be seen. (Auth. summ.)

1100. Bartlett, M. S. 1957. ON THEORETICAL MODELS FOR COMPETITIVE AND PREDATORY BIOLOGICAL SYSTEMS. Biometrika 44 (Parts 1 and 2), June, pp. 27-42.

One aim of the ensuing discussion is to indicate the enhanced value of deterministic formulations of population dynamics when properly interpreted within more comprehensive stochastic models. After some remarks on the logistic model of population growth for a single species, two problems are referred to: (i) the classical Lotka-Volterra predator prey relation, (ii) competition between two species, with special reference to the competition

between the two species of flour-beetle, Tribolium confusum and Tribolium castaneum, as investigated by Park. (V.S.)

1101. Lieder, von Heide. 1957. EININGE HINWEISE FÜR DIE HERSTELLUNG VON FISCHPRÄPARATEN. (Some hints on the preparation of museum specimens of fishes). Deutsche Fischerei Zeitung, No. 7, pp. 203-206.

Several methods for the preservation of fish specimens with as little as possible change in color and shape are listed and evaluated.

In the Kayserling method, specimens are first fixed for several days, depending on size, in a fluid of the following composition: 1,000 ml distilled water, 200 ml formalin, 30 grams potassium acetate and 15 grams potassium nitrate. Fixed fish are then transferred for several hours to 80 percent alcohol in order to improve the color and appearance. They are stored in glass jars in a fluid made out of 1,000 ml distilled water, 200 ml glycerin, and 100 grams of potassium acetate. Two milleliters of phenol are added to prevent growth of molds.

The other method recommended is that of Zymny which is a modification of the Kayserling method. The third method utilizes a 50 percent solution of sucrose for storage of specimens which first are fixed in 1 to 2 percent formalin. Thymol must be added to jars with fish stored in sugar to prevent growth of molds. (S.F.S.)

1102. Schäperclaus, W. 1957. ERGEBNISSE DER VERSUCHE ZUR BEKÄMPFUNG DER INFECTIÖSEN BAUCHWASSERSUCHT IN KARPFENTEICHEN MIT CHLORONITRIN IM JAHRE 1956. (Results of experiments on the control of infectious dropsy in carp ponds with chloramphenicol during the year 1956). Deutsche Fischerei Zeitung, No. 4 for 1957, pp. 113-123.

In previous papers on this subject this author has presented results of experiments on the use of antibiotics, chloramphenicol in particular, for the control of infectious dropsy in carp. In this paper the results of the application of this method of control of this disease on a practical scale in carp culture are presented. The following field tests were performed:

Intraperitoneal injection of dextrorotatory isomer of chloramphenicol was carried out with populations of two year old carp infected with the disease and weighing 150 to 400 grams; each carp received 3 milligrams of d-chloramphenicol. Tests were carried out at several fish farms. The mean mortalities were 67 percent in the control and 16 percent in the treated fish. In another series of ponds the less effective levorotatory isomer of the drug was tested. Treatment also gave satisfactory results with 41 percent mean loss in controls and 11.5 percent in the treated fish.

Experiments on dosage have shown that as little as 1 milligram of d-chloramphenicol given intraperitoneally to carp weighing 300 grams gave satisfactory control of the disease. Dosages smaller than 1 milligram had very little therapeutic effect. In another experiment chloramphenicol was given in equal single doses orally, through the rectum and intraperitoneally. The therapeutic and prophylactic effects were comparable. Treatment of carp by maintaining fish for 24 hours in water containing 0.5 gram of chloramphenicol per liter somewhat reduced losses. However, this method of treatment was not as effective as the intraperitoneal or oral treatments.

The best results of the therapeutic and prophylactic treatment were obtained when the treated carp were transferred to fresh ponds free of untreated infected fish. However, a significant reduction of losses amounting to 50 percent for the growing season of 174 days also took place if treated and untreated carp were kept together in the same pond. (S.F.S.)

1103. Berry, Frederick H., Melvin T. Huish and Harold Moody. 1956. SPAWNING MORTALITY OF THE THREADFIN SHAD, DOROSOMA PETENENSE (GUNTHER), IN FLORIDA. Copeia, No. 3, Aug. 29, pp. 192.

Two incidences of mass mortality were observed, both evidently associated with spawning as adherent shad eggs were conspicuous on hyacinth roots, other plants, and pilings. Temperature change and oxygen depletion are discredited as causative factors. The short average 2-year life span of threadfin shad may be accounted for in the association of mass mortality and spawning. Life history notes of this species are included.

1104. Morrow, James E. 1956. THE JOLTHEAD PORGY, CALAMUS BAJONADO (BLOCH AND SCHNEIDER), A FIRST RECORD FOR NEW ENGLAND WATERS. Copeia, No. 3, Aug. 29, pp. 194-195.

A 9-pound 8-ounce jolthead porgy taken by a dragger off Watch Hill, Rhode Island, on November 25, 1955, is the first recorded north of Bermuda, extending its range 750 miles. It is a southern species whose range includes Brazil, the West Indies, Florida, and Bermuda. Superficially it closely resembles the common scup, Stenotomus chrysops, particularly after the colors have faded, suggesting that it may reach this northern area more frequently than the single record would indicate.

1105. Hemphill, Andrew Frederick. 1957. THE SOUTHERN REDBELLY DACE, CHROSOMUS ERYTHROGASTER ERYTHROGASTER, FROM THE LOWER MISSISSIPPI RIVER DRAINAGE. Copeia, No. 1, April 5, p. 53.

Specimens taken in Bliss Creek, tributary of Yazoo River, 7 miles northeast of Vicksburg, Mississippi, extend the southern range of this subspecies to the lower Mississippi River drainage of Mississippi.

1106. Parker, Robert R. and Walter Kirkness. 1956. KING SALMON AND THE OCEAN TROLL FISHERY OF SOUTHEASTERN ALASKA. Res. Rep. No. 1, Alaska Dept. of Fish., Sept., 63 pp.

Production of king salmon by trolling in Southeastern Alaska began early in the 1900's. Methods of fishing have steadily improved, new grounds have been explored, yet from a peak production of nearly 17 million pounds of dressed fish in 1937, production has steadily declined to a level of about 9 million pounds. This decline in abundance is directly related to the destruction of the spawning and fresh water rearing areas, principally by Federal built dams on the Columbia River.

Tagging in outside waters during the years 1950-1952 has shown the importance of Columbia River contributions to this fishery and especially those fall run races that spawn above Bonneville Dam. The second most important contributor is the Fraser River and all major river systems north of the California-Oregon boundary are shown to contribute, but to a lesser degree. Alaska rivers are relatively unimportant to this fishery.

The outside waters are divided into three areas by the characteristics of the stocks of king salmon found. The stocks found in the area bounded by Cross Sound and Cape Fairweather were composed of relatively small fish with the principal mode of fork length at 27.5 inches. The principal age group found was the 4_1 with the 3_1 group next in importance. The stock as a whole was quite immature, probably in excess of 80 percent. The stocks found on the west coast of Chicagof Island were comparatively larger fish with the principal mode of fork length at the 30.0 and 32.5 inch groups. The principal age group was 4_1 and the 5_1 second in importance. The stock as a whole was quite mature, probably in excess of 80 percent. The stocks found on the west coast of Prince of Wales Island were composed of the largest fish of the three areas. The principal mode of fork length falls almost evenly on the 35.0 and 37.5 inch groups. The age groups 4_1 and 5_1 were of equal importance. The stock as a whole was quite mature probably in excess of 80 percent.

The annual expectation of death from natural causes (other than fishing) is estimated as .341 for the combined areas covered. The question of size limits is examined with the tentative conclusion that regulation of this type will show no profit margin where maximum pounds of fish produced is desired. The combined effect of mortality, caused by hooking and releasing and natural mortality, may even show a loss of profit in pounds of stock. (Auth. summ.)

1107. Shetter, David S. and Leonard N. Allison. 1955. COMPARISON OF MORTALITY BETWEEN FLY-HOOKED AND WORM-HOOKED TROUT IN MICHIGAN STREAMS. Mich. Dept. of Cons., Misc. Publ. No. 9, June, 44 pp.

Results from intensive studies during the 1950-1953 period, both in screened raceways and in the natural stream, provide conclusive evidence that hooking mortality from worm fishing is significantly higher than hooking mortality from artificial-fly fishing. Hooking mortality from worm fishing was: brook trout, 42.37 percent; rainbow trout, 35.4 percent; brown trout, 20.3 percent. Fly fishing killed 3.31 percent of all brook trout, 11.3 percent of the rainbow trout, and 0 percent of brown trout. Hook injury mortality was verified by post-mortem examination.

There was little difference, within each species, in the average size of the fish hooked on worm as compared to fly. Hooking mortality, under a 7-inch legal size limit, takes place mainly among fish in their second summer of life. Under a 10-inch size limit, vulnerability to hooking mortality may extend into the fourth summer of life. The longer a fish is subject to hooking mortality the less chance there is that he will survive to reach an angler's creel. Thus the effect of a higher size limit, imposed to protect a stock to breeding size or to take advantage of good growth conditions, might be lost unless accompanied by lure restrictions to decrease hooking mortality.

Brook trout hooking mortality data applied to 1953 Hunt Creek creel census figures on numbers of short fish released show worm hooking to be responsible for a reduction somewhere between 17 and 32 percent in the potential fall population of 4.0 - 6.9-inch brook trout. Flies were estimated to have reduced the potential fall numbers of trout of the same size range between 0.7 and 1.4 percent. (From auth. concl.)

1108. Schwartz, Frank J. 1956. FIRST RECORD OF INFESTATION AND DEATH IN THE ICTALURID CATFISH, SCHILBEODES MIURUS, BY THE PARASITE CLINOSTOMUM MARGINATUM. Copeia, No. 4, Dec. 31, p. 250.

Three specimens collected from Conneaut Creek, Crawford County, Pennsylvania, died within 2 hours of each other after one month in an aquarium. Investigation of nodules, most numerous in the branchiostegal and gular regions, revealed 3-4 encysted metacercaria of the "yellow grub" Clinostomum marginatum. Since all internal organs were normal, death was attributed to the Clinostomum infestation. Though this parasite has been found in over 22 species including such ictalurids as Ictalurus punctatus, I. catus, and I. nebulosus, this is the first record for Schilbeodes miurus.

1109. Sykes, James E. and Burton A. Lehman. 1957. PAST AND PRESENT DELAWARE RIVER SHAD FISHERY AND CONSIDERATIONS FOR ITS FUTURE. Res. Rep. 46, Fish and Wildlife Service, U. S. Dept. of the Interior, 25 pp.

A study of Delaware River shad was part of an investigation begun by the United States Fish and Wildlife Service in 1950 to supply the Atlantic States Marine Fisheries Commission with information useful in rehabilitating the shad runs of the Atlantic coast. The Delaware River fishery has declined from a peak production of 19 million pounds in 1896 to a level at which it is economically unfeasible for fishermen to operate.

Pollution has had the most severe effect on the runs of shad in recent years, affecting spawners during the upstream migration and both adults and young on their downstream migration. Under present polluted conditions the escapement of young to

the sea is dependent upon river flows sufficient to reduce pollution to tolerable levels at the time of migration. Unless pollution is further reduced, even a river flow of 3 billion gallons a day, which has been recommended by the Interstate Commission on the Delaware River Basin, may not be sufficient to provide favorable conditions for shad.

Construction of dams in the Delaware River at Wallpack Bend and at Barryville, N.Y., has been proposed. Present spawning grounds of shad include the entire area above the Delaware Water Gap. To preserve the remnant runs there, and thus make future rehabilitation of the fishery possible, the river below the Water Gap must be kept open for the passage of shad. If dams are built on the main stem of the river, they must be provided with suitable fishways. (Auth. abst.)

1110. Anon. 1956. BIBLIOGRAPHIA OCEANOGRAPHICA. Vol. 23 (1950), published by the Commissione Internazionale per l'Esplorazione Scientifica del mare Mediterraneo - Delegazione Italiana, Piazzale Delle Scienze, 7 - Rome, Italy. 521 pp.

Index and text of the 2,427 papers are in both English and Italian. Major groupings of subject matter are: The Physical Environment; Stocks of Marine Organisms; Harvesting of Marine Products; Effects of Environmental Changes - Damage to and Protection of the Living Resources of the Sea; Agriculture; Exploitation of the Stocks - Economy of Primary Operations-Administration of Fisheries; Markets, Storehouses, Transportation and Conservation of Fresh Fish Products; Utilization of Fish Products, Ownership, Processing, Conservation; and History and Policy of Fisheries—Regional Studies, National and International Social Aspects and Economics of Fisheries.

1111. Cope, Oliver B. and Daniel W. Slater. 1957. ROLE OF COLEMAN HATCHERY IN MAINTAINING A KING SALMON RUN. Res. Rep. No. 47, Fish and Wildlife Service, U. S. Dept. of the Interior, 22 pp.

Coleman Hatchery was built on Battle Creek, a tributary of the Sacramento River in northern California, to compensate for losses of spawning areas of the king salmon (Oncorhynchus tshawytscha) that resulted from the construction of Shasta Dam. The river was blocked in 1943, and in 1944 studies were inaugurated at Coleman Hatchery to determine (1) how many of the fish entering the valuable sport and commercial salmon fisheries of California had originally been released from the hatchery, and (2) which was the better practice: to release immature salmon from the hatchery in the spring or to release them in the fall.

Paired groups of immature salmon from the 1944, 1945, 1947, and 1948 broods were marked by amputating fins in certain combinations and the fish were released in the Sacramento River—one group in the spring and the other in the fall. Fishery workers inspected the landings in the commercial fishery, principally at Pittsburg, Calif., in the years 1947 through 1952, and others examined salmon taken in the sport fishery on the Sacramento River during some of these years. Records also were kept at the Coleman Hatchery on the marked and unmarked king salmon that returned as adults to the hatchery holding areas during the period 1946 to 1952.

The study revealed that king salmon released in the spring from the hatchery were heavier than those released in the fall, but fall-released fish had entered the commercial fishery in greater numbers than had spring-released fish. Most spring-run stock recovered in the spring had been released from the hatchery in the spring, and the greatest proportion of fall-run stock caught in the fall had been released in the fall. Offspring of spring-run salmon tended to return as adults in the spring runs, and offspring of fall-run salmon predominated in the fall runs.

The average annual percentage of king salmon taken in the commercial gill-net fisheries of California from 1944 to 1948 that was attributable to the Coleman Hatchery was conservatively estimated to be 18.91. (Auth. abst.)

1112. Anderson, William W. 1957. LARVAL FORMS OF THE FRESH-WATER MULLET (AGONOSTOMUS MONTICOLA) FROM THE OPEN OCEAN OFF THE BAHAMAS AND SOUTH ATLANTIC COAST OF THE UNITED STATES. Fish. Bull. No. 120 from Fish. Bull. of the Fish and Wildlife Service, Vol. 57, pp. 415-425.

Ten larval specimens of the fresh-water mullet (Agonostomus monticola) were captured in the open ocean off the Bahamas and South Atlantic Coast of the United States. This is the first record of this species from the open ocean. These larvae are described and illustrated; and certain of their anatomical characters compared with comparable-sized young of Mugil curema and Mugil cephalus.

The suggestion is made that A. monticola spawns at sea, with the young remaining in that habitat until they are about 20 to 35 mm. in length. This would place the species in the list of catadromous fishes. (Auth. abst.)

1113. Vibert, Richard. 1956. LABORATORY METHODS FOR STUDYING AND INCREASING SURVIVAL IN THE WILD OF HATCHERY RAISED TROUT AND SALMON FRY. Extrait des Annales de la Station Centrale d'Hydrobiologie appliquee, Tome VI, pp. 349-439.

The mere fact of artificial incubation in a hatchery ought to be considered as at least partially responsible for the inferior rate of survival in the wild of hatchery fry and fingerlings as compared to wild fry and fingerlings.

Several lots of eggs were used in the tests: Brown trout, rainbow trout, brook trout, and Atlantic salmon. Each lot was divided in two parts, one half hatched in regular hatchery troughs, the other half in the same type of trough with gravel added.

When these batches were tested right after the fry had reabsorbed the yolk sac, the fry hatched under gravel showed themselves to be hardier than

the hatchery fry when tested for ability to: (1) endure temperature extremes, (2) maintain themselves in strong current and (3) survive predation. . . these three factors appearing to be the principal causes for mortality in Nature.

The tests for hardiness used in this study (especially the tests for - Resistance to Current - and - Resistance to Temperature Extremes -) would appear to be useful in related lines of research. It is suggested they could be used in selective breeding experiments designed to develop a strain specifically adapted for ability to survive in the wild, by means of testing separately the progeny of different sets of parents. It is also suggested that these tests could be applied to evaluate the comparative effects on survival in Nature of various hatchery practices such as different methods of incubation, different methods of feeding, transportation, etc... (English summ.)

1114. Penn, George Henry. 1957. VARIATION AND SUBSPECIES OF THE CRAWFISH (ORCONECTES PALMERI (FAXON) (DECAPODA, ASTACIDAE). Tulane Studies in Zoology, Vol. 5, No. 10, Sept. 12, pp. 231-262.

Orconectes palmeri is distributed in streams in south-central United States from southwestern Tennessee and southeastern Missouri to western Oklahoma and the Guadalupe River, Texas, and the Pascagoula River, Mississippi.

The limits of variation of the three previously described subspecies have been studied and the geographic range of each defined. O. palmeri palmeri (Faxon) is limited to the St. Francis River in Arkansas and tributaries on the eastern side of the Mississippi River from the Obion River, Tennessee to Thompson's Creek, Louisiana inclusive; O. p. longimanus (Faxon) is limited to the Arkansas, Red and Ouachita River drainages in Oklahoma, Arkansas, Texas, and Louisiana and Gulf drainage streams west of the Mississippi River; O. p. creolanus (Creaser) is limited to the Lake Pontchartrain drainage in Louisiana and Mississippi and the Pearl and Pascagoula River drainages. An inter-grade area between O. p. palmeri and O. p. longimanus occurs in the White River drainage in northeastern Arkansas. Infrasubspecific ecoclines were found for a number of the characteristics studied.

O. palmeri apparently originated in the late Pleistocene near the head of the old Mississippi embayment. Dispersal from this site of origin was in tributaries of the Mississippi River and subsequently into Gulf drainage streams to the west and east. (Auth. abst.)

1115. King, Joseph E. and Peter T. Wilson. 1957. STUDIES ON TILAPIA AS SKIPJACK BAIT. U. S. Dept. of the Interior, Fish and Wildlife Service, Spec. Sci. Rep.--Fish., No. 225, July, 8 pp.

The cichlid fish, Tilapia mossambica, introduced to Hawaii in 1951 by the Territorial Division of Fish and Game, now has a wide distribution in the islands. During the summer of 1956, tilapia were seined from fresh-water ponds and irrigation reservoirs, acclimatized to sea water, and tested at sea as skipjack bait. The results indicated that tilapia, while inferior in some respects to the native bait (nehu), possessed many desirable qualities. It was concluded that if small tilapia could be produced in large volume at a reasonable price they might alleviate the great need in the Hawaiian skipjack fishery for additional bait supplies. The rearing of tilapia for bait purposes cannot be done most effectively, however, in the presently available ponds and reservoirs with little control over the cannibalistic traits of the species, of predation by other animals, and with the difficulty of harvesting the fish efficiently at an optimum size. (Auth. abst.)

1116. King, Joseph E. and Thomas S. Hida. 1957. ZOOPLANKTON ABUNDANCE IN THE CENTRAL PACIFIC (Part II). Fish. Bull. No. 118 from Fish. Bull. of the Fish and Wildlife Service, Vol. 57, pp. 365-395.

During the period May 1951 to April 1954, 270 quantitative zooplankton hauls were made on 8 cruises to the central equatorial Pacific. The purpose was to obtain a measure of abundance of the standing crop of zooplankton as basic fish food, which measure might be used as an index to the relative productivity of different areas of the sea.

Night hauls yielded volumes averaging 1.57 times that of day hauls; this ratio varied considerably in different subdivisions of the current system. Differences related to the hour of hauling were reduced by an adjustment method based on the similarity of the sine curve and the diurnal variation in zooplankton catch.

The highest concentration of zooplankton was found at the Equator which, under the influence of the trade winds, is a region of divergence and upwelling. Although the greatest abundance of yellowfin tuna occurred just to the north in the convergent zone, there was a high degree of covariation in yellowfin and zooplankton in respect to the current system.

In the east-central Pacific, high concentrations of zooplankton were found along the northern boundary of the Countercurrent. As this is an area of shallow thermocline, high-phosphate water occurs within the photosynthetic zone and within the reach of wind-induced turbulence; conditions are therefore more favorable for plankton production than to the westward where the thermocline deepens.

Within the equatorial region there was a west-to-east gradient of increasing zooplankton abundance from 180° to 150° W. longitude, which varied directly with the yellowfin catch and the average wind velocity, and inversely with thermocline depth. East of 140° W. longitude the catch remained high, but varied irregularly.

Largest zooplankton volumes were taken in the quarter, July, August, and September, the lowest in January, February, and March. Catches were smaller in 1951, 1952, and 1953 than in 1950. There was some evidence of an increase in 1954.

It appears that the zooplankton was quick to respond to physical changes in the environment by

dispersal or concentration following changes in the water mass. With an increase in breadth of the mixing zone at the equatorial divergence, there was a broadening of the zooplankton-rich zone; an increase in velocity of the Countercurrent was accompanied by a marked change in zooplankton distribution.

On long north-south sections, there were highly significant positive correlations between zooplankton volume and surface inorganic phosphate. Although the highest concentration of phosphate was found in the divergent zone at the Equator, agreeing in this respect with zooplankton, longitudinally and seasonally there was some evidence of an inverse relationship with zooplankton and yellowfin; this may have resulted from differences in the rate of utilization. (Auth. abst.)

1117. Taylor, Clyde C., Henry B. Bigelow and Herbert W. Graham. 1957. CLIMATIC TRENDS AND THE DISTRIBUTION OF MARINE ANIMALS IN NEW ENGLAND. Fish. Bull. No. 115, from Fish. Bull. of the Fish and Wildlife Service, Vol. 57, pp. 293-345.

The possible influence of temperature changes on the distribution and abundance of marine species is examined. Mackerel catches show a relation to air temperature fluctuations in data extending over a period of 130 years, the catches having declined to about one-third their former level since 1900 and also having decreased in the amplitude of their fluctuations. Decreased landings of both lobsters and whiting (Merluccius bilinearis) south of Cape Cod may be due to a warming of inshore waters, while north of Cape Cod the warming has produced optimal conditions resulting in greatly increased catches of both species since 1940 and also in late fall and winter catches of whiting. Menhaden, which had not been fished in Maine waters since the end of the 19th century, reappeared there in 1945 and have become commercially exploited.

The abundance of the yellowtail flounder (Limanda ferruginea) has declined on the southern New England fishing grounds while showing an increase on Georges Bank. The decline in the yellowtail flounder and the growth of a thriving fishery for "trash" species on the grounds where the yellowtail was formerly abundant suggests a major ecological change. New northern records of southern species have been published with increasing frequency since about 1930 with no corresponding increase in records of extensions of the southern ranges of northern species, thus indicating these increases are real and not the result merely of an increased number of observers.

The changes in distribution and abundance of marine animals produced by the upswing in temperature fall in several categories and these are discussed. These changes do not appear to have produced any obvious alteration of the general faunal characteristics of the Gulf of Maine region. (Auth. abst.)

1118. Hubbs, Clark and William H. Brown. 1956. DIONDA DIABOLI (CYPRINIDAE), A NEW MINNOW FROM TEXAS. Reprint from The Southwestern Naturalist, Vol. 1, No. 2, April, pp. 69-77.

A new minnow, Dionda diaboli, related to D. episcopa Girard and D. rasconis (Jordan and Snyder) is described. The new species is based on specimens from the Devil's River and other spring-fed tributaries to the Rio Grande in Kinney and Val Verde Counties, Texas. The holotype is University of Michigan Museum of Zoology No. 168971. Several populations of both related species were studied. The species are found to be made up of many isolated and morphologically distinct populations. (Auth. abst.)

1119. Hubbs, Clark. 1957. A CHECKLIST OF TEXAS FRESH-WATER FISHES. Div. of Inland Fisheries, Texas Game and Fish Comm., IF Series No. 3, 11 pp.

1120. Cooper, R. O. 1957. AERIAL FISH DISTRIBUTION IN A MONTANA LAKE. The Prog. Fish-Cult., Vol. 19, No. 4, Oct., pp. 190-191.

During the summer of 1956, 5 tons of rainbow trout (4 million fish) were airplanted in newly impounded 23,000-acre Tiber Reservoir. A Cessna 180 airplane fitted with a specially designed, cylindrical, 94-gallon tank carried approximately 200 pounds of fish and 55 gallons of water per normal load. The tank emptied in 3 seconds through a 10-inch dump valve in the floor of the plane. A single load carried from Great Falls to Tiber Reservoir, a distance of 65 miles, cost approximately $25 compared to $33 for truck transportation.

1121. Clemens, Howard P. and Kermit E. Sneed. 1957. THE SPAWNING BEHAVIOR OF THE CHANNEL CATFISH ICTALURUS PUNCTATUS. U. S. Fish and Wildlife Service Spec. Sci. Rep.--Fish. No. 219, June, 11 pp.

Channel catfish were induced to spawn in glass aquaria by the injection of fish pituitaries. The normal spawning pattern and behavior probably was not modified by the injections. During the prespawning period the male hazed the female and both were belligerent toward other fish. Spawning behavior is described. The spawning act required about 6 hours and eggs were released about 9 times each hour. Bright lights, visitors, or handling the spawners did not materially interfere with or delay the spawning act. The males cared for the eggs after the spawning was completed. Males were used to spawn with more than one female, but the females usually deposited all their eggs during one spawning. (From auth. abst.)

1122. Graham, Joseph J. 1957. CENTRAL NORTH PACIFIC ALBACORE SURVEYS, MAY TO NOVEMBER 1955. U. S. Fish and Wildlife Service Spec. Sci. Rep.--Fish. No. 212, April, 38 pp.

Five cruises were completed by Pacific Oceanic Fishery Investigations during May-November, 1955, to investigate the albacore tuna, Germo alalunga (Bonnaterre), resources to the north and northeast of the Hawaiian Islands. Albacore were scarce in these areas during the late spring and were abundant

during the late summer. The summer distribution was probably discontinuous from east to west with concentrations in the central and eastern North Pacific sectors and a lack of fish in between. During the fall albacore were relatively abundant in this intervening area suggesting that the discontinuity was either a transient condition or had diminished somewhat with the change in season. Catches of surface-swimming albacore were associated with the Polar Front, a transition zone between central and subarctic waters. Surface catches were also associated with a seasonal latitudinal change in surface temperature, particularly about the isotherms 55° to 65° F.

Length frequencies of surface-caught albacore taken in the central and eastern sectors of the North Pacific showed that the same size ranges were sampled on either side of the east-west discontinuity noted above. A latitudinal shift in occurrence similar to that of the albacore was also displayed by other fishes. (Auth. abst.)

1123. Gibbs, Robert H., Jr. 1957. CYPRINID FISHES OF THE SUBGENUS CYPRINELLA OF NOTROPIS. III. VARIATION AND SUBSPECIES OF NOTROPIS VENUSTUS (GIRARD). Tulane Studies in Zoology, Vol. 5, No. 8, Aug. 7, pp. 175-203.

Notropis venustus is redescribed and its three subspecies are characterized and their synonymies given. N. v. venustus consists of two races, one in the affluents of the Gulf of Mexico west of the Mississippi to the Rio Grande and in certain Ozarkian drainages, the other interposed in the Red River and tributaries to the lower Mississippi. N. v. cercostigma has a typical race occupying Gulf of Mexico drainages east of the Mississippi to the Suwannee and another restricted to the upper Chattahoochee River above the Fall Zone. N. v. stigmaturus is found only in the Alabama and Tombigbee Rivers. Apparent intergrades, N. v.: cercostigma x stigmaturus are found in the lower part of the Alabama system.

The closest relative of N. venustus appears to be N. spilopterus. N. venustus is believed to have originated somewhere in the Gulf of Mexico tributary system, and to have dispersed through the more or less brackish estuaries and embayments. Where populations have reached above a zone of rapids, differentiation has been accelerated, giving rise to N. v. stigmaturus and the Upper Chattahoochee Race of N. v. cercostigma. (Auth. abst.)

1124. Lund, William A., Jr. 1957. MORPHOMETRIC STUDY OF THE STRIPED BASS, ROCCUS SAXATILIS. U. S. Fish and Wildlife Service Spec. Sci. Rep.--Fish. No. 216, July, 24 pp.

Morphometric characters were found to be good indicators for separating populations of striped bass found along the Atlantic coast. Standard length, head length, predorsal distance, prepelvic distance, body depth, and caudal-peduncle depth were the characters used. The data were analyzed by appropriate F-tests in an analysis of covariance. Standard length was used as the independent variable in all comparisons, and all other characters were employed as dependent variables.

On the basis of this study, it is believed that there are at least four populations of striped bass in Chesapeake Bay and its tributaries. The data also revealed that the Hudson River and Albemarle Sound contain distinct populations. Specimens collected above Pinopolis Dam, in the Santee-Cooper River System in South Carolina were found to have a greater body depth and a thicker caudal peduncle than samples collected below the dam. The striped bass exhibited north-south clines with respect to body and caudal-peduncle depths. (Auth. abst.)

1125. Austin, Thomas S. 1957. SUMMARY, OCEANOGRAPHIC AND FISHERY DATA, MARQUESAS ISLANDS AREA, AUGUST-SEPTEMBER, 1957 (EQUAPAC). U. S. Fish and Wildlife Service Spec. Sci. Rep.--Fish. No. 217, May, 186 pp.

In the late summer (August-October) of 1956, two research vessels from POFI cooperated with those of three other organizations in a quasi-synoptic oceanwide survey of the Pacific Ocean. Operating in the area of the Marquesas Islands, the Hugh M. Smith made detailed physical, chemical, and biological observations in order to define features of oceanic circulation and to obtain information on the abundance and distribution of plant and animal life. Also operating in that area, the Charles H. Gilbert sought to evaluate the tuna resources by longline and live-bait fishing, by trolling, and by observation of fish schools and bird flocks. Data thus obtained are presented here with a description of the field and laboratory procedures involved. (Auth. abst.)

1126. Schiemer, Edmund W. and Donald William Pritchard. 1957. THE CHESAPEAKE BAY INSTITUTE CONDUCTIVITY-TEMPERATURE-INDICATOR (CBI-CTI). Tech. Rep. 12, Chesapeake Bay Inst., The Johns Hopkins University, January, 53 pp.

The design, construction, and operational characteristics of this in situ measuring device is described. Photographs, plan layouts, and a parts list are provided. In field use, a surface sample for titration and a surface temperature permitted maintenance of accuracies of ±0.05° C. and ± 0.05% salinity.

1127. Hubbs, Carl L. and Walter R. Crowe. 1956. PRELIMINARY ANALYSIS OF THE AMERICAN CYPRINID FISHES, SEVEN NEW, REFERRED TO THE GENUS HYBOPSIS, SUBGENUS ERIMYSTAX. Occasional Papers of the Museum of Zoology, Univ. of Mich., No. 578, Aug. 24, 8 pp.

Differential diagnoses for several species and subspecies recently referred to the genus Erimystax but once again placed in the genus Hybopsis. No attempt at generic evaluation is made.

1128. Munro, W. R. and K. H. Balmain. 1956. OBSERVATIONS ON THE SPAWNING RUNS OF BROWN TROUT IN THE SOUTH QUEICH, LOCH LEVEN. Scottish Home Dept. Freshwater and

Salmon Fisheries Research, No. 13, 17 pp.

This paper describes observations made at Loch Leven in the winters of 1952-1953 and 1953-1954 during attempts to enumerate, by trapping, the entire spawning population of one of the main spawning streams. During the first spawning season, when the count was complete, 14,231 trout entered the trap. During the second season, when heavier spates (floods) prevented a complete count, 8,831 trout were examined. The sex of each fish was recorded and a proportion was measured. During both seasons females were more numerous than males, comprising 59.2 percent of the total count in 1952-53 and 70.4 percent in 1953-54. The proportion of females increased in the later runs. There was little appreciable difference in the average length of the fish entering the trap at the beginning and the end of the season.

During the first season records of water level and temperature of loch and stream were kept. In addition, during the second season, pH, alkalinity and turbidity were determined on samples of water from the stream. There appeared to be no relationship between water temperature conditions and the incidence of the runs. On every occasion the commencement of a run was associated with an increase in water level. It is therefore concluded that an increase in water level or some change in the nature of the water associated with such a rise is the most important stimulus inducing the upstream migration of trout to the spawning beds. (Auth. summ.)

1129. Sarig., S. 1956. THE IMPORTANCE OF POND FISH CULTURE IN WINTER. Bamidgeh, Vol. 8, No. 5, Dec., pp. 75-79.

Winter growth of carp under Israel's climatic conditions adds about 10-15 percent to pond yields. This is of considerable economic importance as the yield increase is achieved with minimal amounts of supplementary food and this yield is marketed during a season of fish shortage.

Arguments against winter culture are that the fertility of ponds is conserved by "winter rest," a fallacious opinion based on European literature covering conditions different than Israel's; that ponds used for winter culture are less fertile than those drained, a fact proven many times and worthy of investigation; and that Prymnesium outbreaks are most severe during winter months resulting in considerable increase in control measures and work, but the cost of control does not affect the increase of income or other positive aspects of winter culture except in areas of severe attacks.

In general, climatic conditions of Israel most certainly justify winter culture.

1130. Yashouv (Wirszubski), A. 1956. PROBLEMS IN CARP NUTRITION. Bamidgeh, Vol. 8, No. 5, Dec., pp. 79-87.

An evaluation of the importance of animal food in the diet of carp revealed under aquaria conditions that a small addition of chironomids notably increases the growth of carp. A statistically significant, though smaller, increase in growth was also obtained by the addition of Daphnia. As the amount of Chironomids and Daphnia added to the diet was so small as to have little effect as ordinary food, it is concluded that their addition provided special growth substances deficient in the diet mixture alone.

Additional experiments dealt with the preparation of a balanced diet with no natural food. Additives were dried powdered liver, powdered yeast, and a mixture of yeast and liver in equal parts. The supplemented diets resulted in much more rapid growth than the basic mixture. Vitamin B complex is considered to be the most important, vitamins A and D in liver apparently not being required by carp.

Contrary to accepted opinion among fish culturists that fish growth is best in ponds developed to an extent bordering on oxygen deficiency, all instances of oxygen deficiency observed by the author caused fish to lose weight. The precise nature of the process involved is not known. Furthermore, population density itself is not considered a decisive factor in growth. Planned supplementary feeding can counteract a decline in food sources, so that the negative effect of density on growth is considered a result of other factors. Accumulation of excreta may be responsible, but this supposition remains to be proved.

1131. Pruginin, Y. 1956. IMPROVEMENTS IN THE CONSTRUCTION OF SPAWNING NESTS FOR CARP. Bamidgeh, Vol. 8, No. 5, Dec., pp. 88-91.

Waste material from the manufacture of Saran plastic window-netting has proven to be convenient, long lasting, and an inexpensive substitute for the usual carp spawning beds of conifer branches or clover plantings. The new beds consist of cotton net bags filled with Saran fibers stretched on iron frames. These are easily removed after spawning to fry ponds and adults may be removed and separated to achieve additional spawnings during the year.

1132. Moody, Harold L. 1957. A FISHERIES STUDY OF LAKE PANASOFFKEE, FLORIDA. Qtrly. J. of the Fla. Acad. of Sci., Vol. 20, No. 1, March, pp. 21-88.

Lake Panasoffkee, covering about 7 square miles, is shallow, long and narrow. This study, consisting of rough fish removal by haul seine, tagging and recovery, and creel census, was conducted to determine the effects of rough fish removal on sport catch and total lake populations and to provide useful information of an ecological nature for fishermen.

During the 13-month period October 1953 to October 1954, a total of 153 seine hauls took approximately 300,000 pounds of fishes, 200,000 pounds of which were non-game fishes. The area covered by the average seine haul was about 40 acres, the average number of hauls per month was 12, and recruitment of smaller size groups into the range of net selectivity was rapid. More gizzard shad and garfishes were taken during the last month of operation than in the month seining began.

Populations of rough fishes were not significantly affected by, nor did noticeable improvement in sport-fishing success result from non-game fish removal

by haul seine. Fishes traveled, sometimes over long distances, between the Lake, sloughs and streams, and the River. A gradual decline in total fish populations appeared to be directly related to a steady recession in water level. Sharply reduced numbers of gizzard shad in mid-spring were apparently the result of a massed spawning mortality. Proportions of game-fishes taken by sportfishing methods were roughly equivalent to proportions taken by haul seine. Most of the fishing effort was directed toward catching bream, which also constituted the bulk of the sport catch. The average fisherman caught 0.6 bass, 1.0 crappie, or 1.7 bream per hour of effort. The length of his average fishing trip was about 4 hours.

1133. Hubbs, Clark and Kirk Strawn. 1956. INTERFERTILITY BETWEEN TWO SYMPATRIC FISHES, NOTROPIS LUTRENSIS AND NOTROPIS VENUSTUS. Reprint from Evolution, Vol. 10, No. 4, Dec., pp. 341-344.

There appears to be no genetic barrier to interbreeding between these species, at least between members of populations studied in aquaria. Furthermore, though studies have not been completed on the relative fertility of various F_1 offspring, it appears that interspecific hybrids are as successful and as fertile as any others.

Repeated simultaneous capture of young of both species indicates no seasonal reproductive isolation. Mate recognition or breeding site selection are suspected of being the major isolating factors in areas where they do not interbreed. In the few areas where hybrid swarms occur, environmental disturbances may well have broken these barriers.

1134. Hubbs, Clark and Kirk Strawn. 1957. RELATIVE VARIABILITY OF HYBRIDS BETWEEN THE DARTERS, ETHEOSTOMA SPECTABILE AND PERCINA CAPRODES. Reprint from Evolution, Vol. 11, No. 1, March, pp. 1-10.

A sample of F_1 hybrids between the orangethroat darter and the logperch stocks from the San Gabriel River, Texas, varies widely in a number of morphologic characters. A similar variability of natural hybrids is often used as a criterion for hybrid fertility. Assuming hybrid fertility based only on high variability of wild hybrids is to be avoided.

No fertility is known in hybrids of this combination and is not expected. Hybrids of the same combination from Colorado River stocks are no more variable than their parental stock. (Auth. summ.)

1135. Wohlschlag, Donald E. 1956. INFORMATION FROM STUDIES OF MARKED FISHES IN THE ALASKAN ARCTIC. Reprint from Copeia, No. 4, Jan. 4, pp. 237-242.

Marking of larger whitefishes in arctic lakes is possible either by fin clipping or by use of plastic Petersen discs. After a period of over two years, partially clipped paired fins and completely clipped adipose fins did not regenerate and cellulose nitrate discs with nickel wire fastenings did not deteriorate.

Two years after initial mark-and-recapture studies in Ikroavik Lake, the results of a resampling indicated that the population of Coregonus sardinella over 180 millimeters long must have remained isolated in the lake, must have remained at about the same population level (5700), must have retained about the same level of annual mortality (about 0.59 per year), and must have remained in a fairly uniform distribution within the lake. Likewise the population of Coregonus nasus over 180 millimeters long seemed to remain constant (less than 600) and isolated over the two-year period during which a very low mortality rate for the larger fish was indicated. For five individually recognizable recaptures, there was rapid growth for the middle-aged fish and very slow growth for the oldest and largest fish; for these same recaptures, scale annuli were compared for both the 1952 and 1954 scales with a clear indication that the scale method of age and growth determination was valid. It is concluded that similar fish populations of many arctic Alaskan lakes could be studied by means of mark-and-recapture techniques for estimates of population size, mortality rates, and growth and recruitment rates.

Some of the anticipated difficulties of mark-and-recapture procedures for studying small, transitory, and widely dispersed populations in coastal waters are discussed. (From auth. summ.)

1136. Strawn, Robert Kirk. 1957. THE INFLUENCE OF ENVIRONMENT ON THE MERISTIC COUNTS OF THE FISHES, ETHEOSTOMA GRAHAMI AND E. LEPIDUM. Dissertation Abstr., Vol. 17, No. 8, p. 1842.

Culture methods for the Rio Grande darter, Etheostoma grahami (Girard), and for the greenthroat darter, E. lepidum (Girard), are discussed. Data on the ecology and life history of wild and laboratory greenthroat darter populations are presented.

Lateral line scale, anal soft ray, first dorsal ray, second dorsal ray, and left pectoral ray counts of laboratory-raised lots and field populations of the Rio Grande and greenthroat darters are compared. Meristic differences between sexes are small or nonexistent. Means of natural populations are quite variable, but no definite clines exist. The means of lateral line and pectoral counts of spring populations frequently are significantly lower than those of downstream populations. Adjacent populations may have significantly different means, and the correlation between size and number of lateral line scales within some populations is highly significant. These differences are taken to signify different or changing environments during development. Lots from a single pair raised under different environmental conditions can have means more divergent than those observed in the various populations from their parental geographic region.

The variances of wild populations are similar to those found in laboratory lots. High variances probably correlate with environmental factors rather than genetic differences. The diet of the parents and prolonged nipping of a female by a male correlate with the production of deformed and inviable larvae. The few survivors of these lots tend to be runted and

to have highly variable counts. Lack of proper-sized food and/or inability of some larvae to take food as soon as normal fish in the laboratory causes runting and apparently increases the variance of meristic characters. Four lots had extremely high variances of undetermined origin. F_2 interspecific and interpopulational lots have high variances demonstrating genetic differences between the parental populations.

All counts appear plastic during the free-swimming stage. The lateral line and probably the first and second dorsal counts are temperature liable until after the adult mode of life on the bottom has been assumed. In a heterogenous temperature environment the choice of time and place of egg deposition by the parents can influence counts determined before hatching, and temperature preference of the larvae can modify counts which are plastic after hatching. (Auth. abstr.)

1137. Snieszko, S. F. and G. L. Bullock. 1957. DETERMINATION OF THE SUSCEPTIBILITY OF AEROMONAS SALMONICIDA TO SULFONAMIDES AND ANTIBIOTICS, WITH A SUMMARY REPORT ON THE TREATMENT AND PREVENTION OF FURUNCULOSIS. Prog. Fish-Cult., Vol. 19, No. 3, July, pp. 99-107.

The number of outbreaks of fish furunculosis from which sulfonamide-resistant cultures of Aeromonas (Bacterium) salmonicida are isolated, is on the increase. Therefore, a reliable method for determining sulfonamide sensitivity under field conditions has been described. If an outbreak of furunculosis is caused by a sulfa-resistant strain of the pathogen, treatment with chloramphenicol or oxytetracycline is recommended. Details of chemotherapy and prophylaxis of furunculosis are discussed. (Auth. abstr.)

1138. Sowards, Charles L. 1957. AN EVEN-FLOW LIQUID TOXICANT DISPENSER. Prog. Fish-Cult., Vol. 19, No. 3, July, p. 107.

The control of fish populations in streams through the use of liquid fish toxicants and potassium permanganate requires a constant regulated flow of these liquids for even distribution. Use of the needle valve and float assembly of a large carburetor has proven successful. The only modification necessary is the installation of a 5/16-inch straightway petcock in the bottom of the carburetor bowl. At least 6 inches of head pressure are required to maintain a constant flow.

1139. Lennon, Robert E. 1957. NEW USE FOR SALT BEING INVESTIGATED. Prog. Fish-Cult., Vol. 19, No. 3, July, p. 111.

Cattle-salt blocks have been successfully used in streams in the Shenandoah and Great Smoky Mountains National Parks to determine water volumes and velocities and to lower resistivity of selected streams thereby increasing efficiency of electrofishing operations.

1140. Scidmore, W. J. 1957. AN INVESTIGATION OF CARBON DIOXIDE, AMMONIA, AND HYDROGEN SULFIDE AS FACTORS CONTRIBUTING TO FISH KILLS IN ICE-COVERED LAKES. Prog. Fish-Cult., Vol. 19, No. 3, July, pp. 124-127.

Water samples were taken through the ice of 6 southern Minnesota lakes having maximum depth of 10 to 35 feet. Two of these lakes had no winterkill during the period of study.

Data obtained indicate that the dissolved oxygen level is the best basis for forecasting winterkills. Although high concentrations of ammonia, carbon dioxide, and hydrogen sulfide may be associated with winterkills, oxygen appears to be the most causative factor. As ammonia, carbon dioxide, and hydrogen sulfide are associated with decomposition and thus with conditions of reduction and low oxygen, it is likely that winterkills are usually related to concentrations of these gases as concurrent phenomena rather than as the cause and effect. There is the possibility that increasing concentrations of carbon dioxide reduce the ability of the fish to utilize oxygen; but the present evidence indicates that it is not possible to separate the individual effects of the four gases considered. Dissolved oxygen apparently provides the best single index of suitability of the water for fish in lakes where winterkill is a potential.

1141. Bertullo, Victor H. 1957. SILVERSIDES PLANTED IN URUGUAY. Prog. Fish-Cult., Vol. 19, No. 3, July, p. 127.

Planting more than 1 hundred thousand Pejerreyes, or silversides (Odonthestes bonaerensis), in the Canelon Grande Dam in Uruguay last February marked the start of a campaign to stock all suitable waters with fish. In the next 5 years about 1 million Pejerreyes per year will be planted. The project was undertaken by the Servicio Oceanografico y de Pesca, the Consejo Departamental de Canelones, and the Departamento de Investigaciones Pesqueras y Biologia Marina, Facultad de Veterinaria, Universidad de la Republica del Montevideo, Uruguay.

1142. Bezdek, Francis H. 1957. SODIUM SECONAL AS A SEDATIVE FOR FISH. Prog. Fish-Cult., Vol. 19, No. 3, July, p. 130.

Forty-five adult (2.5- to 3-inch) minnows (Pimephales promelas) were placed in 1.5 quarts of water at a temperature of 50° F. A 0.75-grain (0.05-gram) capsule of sodium seconal was added to the water.

The effects of the drug began to show about half an hour after its administration. The symptoms among the fish included sluggishness, rolling from side to side, and retarded breathing. Ten fish were removed to fresh water after 1 hour in the drugged solution. They revived in about 3 hours. The 35 other fish were put in fresh water after spending 3 hours in the drugged solution. All these fish were completely revived in 5 hours.

1143. Anon. 1957. STUDY OF TISSUE IN PANCREATIC NECROSIS. Prog. Fish-Cult., Vol. 19, No. 3, July, p. 133.

In preliminary trials a saline extract was made of tissues from brook trout fry that had the "whirling" symptoms of pancreatic necrosis. This extract was

clarified, filtered to remove bacteria, and then used to inoculate growing cultures of trout tissue. Within 4 days the inoculated cultures degenerated, while uninoculated control cultures did not exhibit such a change. Similar changes were observed, however, when small amounts of fluid from degenerated cultures were added to other growing cultures. The calculated dilution of the original saline extract was 1,600-fold.

These results may be cautiously interpreted as evidence supporting a virus cause, but at this stage of the study they are not proof that pancreatic necrosis is due to a virus infection.

1144. Pechacek, Louis S. and Charles L. Sowards. 1957. CARRYING RACK FOR OUTBOARD BOATS AND MOTORS. Prog. Fish-Cult., Vol. 19, No. 3, July, pp. 134-136.

The design details and material list to construct a carrying rack for pick-up trucks is provided. Designed to carry a 12-foot boat and one or more motors, it is strong, but simple in construction. The entire truck bed is left open for hauling other equipment. The rack and motor mount can be built in 6 hours.

1145. Seaburg, Keith G. 1957. A STOMACH SAMPLER FOR LIVE FISH. Prog. Fish-Cult., Vol. 19, No. 3, July, pp. 137-139.

This device permits the removal of the entire stomach contents of all size fish without injury. It consists of two copper tubes, the smaller tube being fitted with a rubber tube and suction bulb to produce a unidirectional flow of flushing water and the larger tube being attached to the lid of a specimen bottle. Excess water escapes through a screened hole in the bottle cap. Operation and construction details are provided.

1146. Louder, Darrel E. and William M. Lewis. 1957. STUDY OF A STOCKING OF THE REDEAR AND BLUEGILL IN SOUTHERN ILLINOIS. Prog. Fish-Cult., Vol. 19, No. 3, July, pp. 140-141.

Lake Murphysboro, a 160-acre artificial impoundment in Jackson County, was filled and stocked in 1950 with adult largemouth bass, bluegill, redear sunfish, and channel catfish. The present population also includes white crappie, green sunfish, warmouth, and yellow bullhead. A creel census in 1955 revealed that 1,117 man-hours of fishing with worms and cockroaches resulted in a catch of 1,444 bluegill and 295 redear sunfish, a rate of catch of 1.29 and 0.26 fish per hour, respectively. A similar creel census in 1956 revealed 3,351 man-hours and a catch of 2,600 bluegill and 310 redear or 0.78 bluegill and 0.09 redear per hour of effort.

Observations on loss of fish over the spillway showed a greater loss of redear than bluegill and that a greater percentage of the redear population was made up of larger catchable fish than in the bluegill population. Growth studies also revealed the redear to be growing at a faster rate than the bluegill. A coefficient of condition study indicated that the redear was more plump than the bluegill. The low catchability of the redear seems to be its weakest attribute.

1147. Minckley, W. L. 1957. EFFECT OF SUBSURFACE PERCOLATION ON WATER TREATED WITH ROTENONE. Prog. Fish-Cult., Vol. 19, No. 3, July, p. 141.

By stocking redbelly dace and orangethroat darter in seven holes which filled almost immediately after being dug in the dry stream bed of an intermittent stream, allowing these fish to acclimatize for one day, and then applying wettable-powder rotenone to the upstream pool, it was demonstrated that no subsurface percolation took place. No dead fish were recovered in any of the downstream holes in three days while a complete kill was obtained in the rotenoned pool.

1148. Hansen, Donald F. 1957. USE OF STAK-TYPE BOAT ANCHORS IN WING-NET FISHING. Prog. Fish-Cult., Vol. 19, No. 3, July, pp. 142-143.

Material and construction of this device, consisting of verticle sleeves attached to each end of a boat through which metal stakes are driven into the bottom to anchor the boat, are discussed. Its primary advantage is to permit one man to lift and reset hoop nets.

1149. Perkins, Frank E. 1957. A FIELD TECHNIQUE FOR OBTAINING SAMPLES OF FISH BLOOD SERUM. Prog. Fish-Cult., Vol. 19, No. 3, July, p. 144.

This technique involves the use of Pasteur pipettes drawn from No. 7 soft glass tubing (outside diameter, 7 millimeters) with the finished inside diameter of the tip dependent on the size of the fish.

The pericardium and sinus venosus are pierced from beneath the operculum with a posterior and ventral orientation of the needle. A baffle, 2 inches in diameter and made from an ordinary tire tube, surrounds the upper middle portion of the needle and prevents contamination by mucus or sea water. The blood is drained by heart action and collected in 8-dram shell vials. The vials are corked at once after blood is taken. The clot is allowed to express, and the serum is removed with pipettes prepared in a manner similar to that for the needles --in fact, they may be interchanged. Thus, needles and pipettes are inexpensive enough to discard if necessary after use under field conditions.

1150. Horton, H. F. and Austin Pritchard. 1957. EFFECT OF RAUWOLFIA ALKALOIDS ON THE OXYGEN CONSUMPTION RATE OF HATCHERY-REARED RAINBOW TROUT. Prog. Fish-Cult., Vol. 19, No. 3, July, pp. 131-133.

Rainbow trout (Salmo gairdneri Richardson) were subjected to concentrations of 10, 100, and 1,000 ug% reserpine, rauserfia, and raunormine for 2 1/3 hours at 15° C. in sealed aquaria. No significant difference in oxygen consumption rate (cc./g./hr.) occurred between test and control animals. A pronounced dilation of the melanophores in the experimental fish was observed. Color changes began

approximately 30 minutes after exposure to the drugs and persisted from 1 to 3 days. No tranquilizing or sedative effect was apparent. (Auth. abstr.)

1151. Allison, Ray. 1957. A PRELIMINARY NOTE ON THE USE OF DI-N-BUTYL TIN OXIDE TO REMOVE TAPEWORMS FROM FISH. Prog. Fish-Cult., Vol. 19, No. 3, July, pp. 128-130.

Di-n-butyl tin oxide incorporated into the feed at the rate of 0.28 percent gave 100 percent control of the tapeworm Corollobothrium fimbriatum in channel catfish receiving medicated feed at the rate of 3 percent of their body weight per day for 3 days. This treatment also gave 100 percent control of an intestinal fluke, Alloglossidium corti. Kamala gave controls of 27 percent and 50 percent, respectively, for these two parasites. (Auth. abstr.)

1152. Halver, J. E. and J. A. Coates. 1957. A VITAMIN TEST DIET FOR LONG-TERM FEEDING STUDIES. Prog. Fish-Cult., Vol. 19, No. 3, July, pp. 112-118.

A vitamin test diet for long-term feeding studies was developed. This contained (in %) vitamin-free casein supplemented with DL-methionine and L-tryptophan 55, purified gelatin 15, corn oil 7, cod-liver oil 2, white dextrin 8, α-cellulose flour 9, and mineral mixture 4. To 100 gm. of this basal diet was added (in mg.) thiamine HCl 6, riboflavin 20, pyridoxine HCl 4, nicotinic acid 80, calcium pantothenate 28, inositol 400, biotin 0.6, folic acid 1.5, p-aminobenzoic acid 40, choline 800, ascorbic acid 200, α-tocopherol acetate 40, mendaione 4, and crystalline vitamin B_{12} 0.009. The diet containing 25 percent solids was prepared by adding the other dry ingredients to a warm 5 percent gelatin solution and blending thoroughly in a mechanical mixer. Diet consistency could be controlled by varying the speed of the mixer. Rainbow trout fed exclusively on this diet for two reproductive cycles showed no recognizable vitamin-deficiency syndromes and produced normal numbers of eggs and actively feeding fry. (Auth. abstr.)

1153. Phillips, A. M., Jr. and D. R. Brockway. 1957. THE NUTRITION OF TROUT: IV. VITAMIN REQUIREMENTS. Prog. Fish-Cult., Vol. 19, No. 3, July, pp. 119-123.

A summary article in which the vitamin requirements of trout are discussed. Folic acid, biotin, thiamine, pantothenic acid, pyridoxine, riboflavin, niacin, choline, inositol, and vitamin B_{12} are listed as essential for trout. Reasons for possible differences in requirements for four species—brook, brown, lake, and rainbow trout—are discussed. (Auth. abstr.)

1154. Allison, Leonard N. 1957. VARIATION IN STRENGTH OF PYRIDYLMERCURIC ACETATE TECHNICAL AND ITS EFFECT ON RAINBOW TROUT. Prog. Fish-Cult., Vol. 19, No. 3, July, pp. 108-111.

Pyridylmercuric acetate technical was used successfully in Michigan for several years to treat disease among rainbow trout, although experiences in other states indicated that it could be lethal to rainbow trout. Brook and brown trout are not adversely affected by the chemical. In one year several instances of high mortality among rainbow trout followed treatment with PMA. The fact that PMA from two sources was involved suggested that the chemical from only one of the sources might be lethal to fish. Subsequent tests revealed that different batches of the chemical differed somewhat in PMA content. The manufacturer of PMA stated that the company guaranteed only a PMA content of 80 percent for the product and that it might contain much more, and that there was a variation in the amount of impurities which might also have some toxic effect on fish. Tests were made on rainbow trout with samples assaying 81.8 percent, 84.4 percent, 84.8 percent, and 87.3 percent PMA content, in dilutions of 1:400,000, 1:500,000, and 1:600,000. No mortality ensued from treatment with the first three percentages. Mortality did result from all dilutions of the 87.3 percent sample; but comparisons of relative mercury concentrations of the dilutions with those of the 81 percent sample were not consistent, indicating that some impurity was present. It is recommended that if rainbow trout are to be treated with PMA, aquarium tests should be made first with a small number of fish. As mortalities due to PMA do not begin until several hours after treatment, it is suggested that some antidote might be found for use immediately after treatment. (Auth. Abstr.)

1155. Moon, Frank W., Jr., Charles L. Bretschneider and Donald W. Hood. 1957. A METHOD FOR MEASURING EDDY DIFFUSION IN COASTAL EMBAYMENTS. Publs. of the Inst. of Mar. Sci., Vol. 4, No. 2, July, pp. 14-21.

The method described consists of introducing a fluorescent dye into water at a point of interest and taking measurements along its path. A description of the instrument used for detection of trace quantities of fluorescein in water masses and an analysis of data obtained during a preliminary operation run are included. Continuous sampling is possible. Concentrations somewhat less than 10^{-6} grams in one kilogram of sea water can be detected. This method of determining diffusion should prove of value in problems concerning waste and sewage disposal and in other studies where an accurate evaluation of diffusion is required.

1156. Odum, Howard T. and Charles M. Hoskin. 1957. METABOLISM OF A LABORATORY STREAM MICROCOSM. Publs. of the Inst. of Mar. Sci., Vol. 4, No. 2, July, pp. 115-133.

A flowing water laboratory stream microcosm was constructed in which it was possible to culture and study the growth, succession, and metabolism of whole aufwuchslime communities. The communities developing in the microcosm during succession, resembled communities in nature with respect to gross primary production - respiratory oxygen change ratio (0.6—1.3), chlorophyll (0.03—0.38 gm/

m^2), assimilation number (1—3 mg/mg/hr), species diversity index (2—13 species/cycle), efficiency (3%), and the low concentrations of nitrate (0.05 ppm) and phosphate (0.005 ppm) maintained in the medium.

Under conditions of constant illumination steady state adjustments of whole aufwuchs communities are possible for considerable times with an excess of respiration over photosynthesis as well as with a balance of photosynthesis and respiration. During community succession metabolism was maximal during succession rather than at climax.

The metabolism of successional and steady states of whole communities is a complex function of the current velocity. There is a greater metabolism at greater velocities in many cases but not all. Aufwuchs communities show strong powers of taking up both dissolved inorganic and organic nutrients for future use both as raw materials and as an energy source. Pigment changes of the blue-green algal mats of the aufwuchs from green to orange were a sensitive visible indicator of the metabolic condition of the community. (Auth. summ.)

1157. Breuer, Joseph P. 1957. AN ECOLOGICAL SURVEY OF BAFFIN AND ALAZAN BAYS, TEXAS. Publs. of the Inst. of Mar. Sci., Vol. 4, No. 2, July, pp. 134-155.

The Baffin-Alazan Bay phase of this general study of the Laguna Madre system of Texas began in June of 1951 and terminated in May of 1953. The area studied consisted of Baffin and Alazan Bays, Cayo del Grullo, Los Olmos Creek, and Cayo Infernillo, the entire area covering about 60,000 acres at mean high tide. Physical characteristics which make the area different from most Texas bays are the soft mud bottom, the absence of tidal effect except for wind tides, the lack of suitable stream discharge, and the resulting lack of water circulation and exchange. The salinity for the two-year period averaged 51.68 parts per thousand, pH 7.91, and the turbidity 85.4 measured by percent of light transmission.

All biological components were studied except bacteria, foraminifera, and nannoplankton. Biological characteristics which are most noteworthy are the complete absence of spermatophytic vegetation, the almost complete lack of microscopic algae, and the extremely heavy copepod population. In general, the total number of both plant and animal species is very limited, but those forms which are present are available in large quantity. Among the factors which limit the number of species are the normally high salinity, the normally turbid condition of the water, and the inaccessibility to the Gulf of Mexico. Of 993 fish tagged in the area, 966 were black drum (Pogonias cromis). Although some drum spawned near the mouth of Baffin Bay, their presence in the area seemed to be correlated with food, particularly during the fall and winter months. Because of its geographical location and its physical and meteorological aspects, this hypersaline area is unlike any other bay area on the Texas coast, resulting in a great faunal difference from other bays under study. (Auth. summ.)

1158. Simmons, Ernest G. 1957. AN ECOLOGICAL SURVEY OF THE UPPER LAGUNA MADRE OF TEXAS. Publs. of the Inst. of Mar. Sci., Vol. 4, No. 2, July, pp. 156-200.

The upper Laguna Madre is a long narrow lagoon characterized by shallow flats, noted for hypersalinity, heavy fish populations, and discolored water. No true reefs are present but serpulid "rock" is plentiful near Baffin Bay. The average depth of the area is three feet; the average width is four miles. At the northern end water flow is restricted by an earth-fill causeway; on the south a similar restriction is caused by a large bar. Thus the area is similar to a lake. The watershed is small and waterflow into the area is limited to creeks in the Baffin Bay area. Padre Island on the east and desolate rangeland on the west prevent utilization of the area from land, but numerous boats plied the water.

Periodically fish have been killed by extremely cold weather and by hypersalinity. The intracoastal Waterway, finished in 1948 and extending the length of the lagoon, has practically eliminated mortality caused by hypersalinity. Water temperature over a four-year period has ranged from 4° to 35° C. Salinity prior to the dredging of the Intracoastal Canal reached 113.9 percent. The highest salinity recorded after completion of this project was 79.0 percent. Water of high salinity and that of lower salinity did not mix well. The water of higher salinity moved as a block with prevailing winds and tides. Salinity was in direct ratio to local rainfall, particularly torrential rainfall in September and October. Many attempts have been made to open passes from the Gulf to the lagoon. All have been failures. Each pass closed quickly at the Gulf entrance and water that entered did not mix well with the water of the lagoon.

As the salinity increased, the number of species decreased; the number of individuals of each available species increased up to the optimum which is usually around 45 percent and 25° C. In many instances the average size of the vertebrate individual increased with the salinity increase, while the average size of the invertebrate individual decreased. A total of 22 faunal species tolerated salinity of 75 percent. Eighteen additional species withstood salinity to 60 percent; 51 more species were limited if the salinity was above 45 percent and 21 species were not tolerant of salinity above 30—35 percent. In general, high salinity and high temperature coincided. In a few cases where high salinity and low water temperature coincided it was found that various forms tolerated a much higher salinity than they normally could. Tidal effects on salinity were not notable except for the moving of a hypersaline "block" from one end of the lagoon to the other. High salinity over a period of several months completely eliminated widgeongrass and restricted growth of shoalgrass. (From auth. summ.)

1159. Robinson, Maryanne. 1957. THE EFFECTS OF SUSPENDED MATERIALS ON THE REPRODUCTIVE RATE OF DAPHNIA MAGNA. Publs. of the Inst. of Mar. Sci., Vol. 4, No. 2, July, pp. 265-277.

The reproductive rate of Daphnia magna was studied in cultures containing 0–1458 ppm of suspended materials. These materials were shown to be filtered and passed through the gut of the Daphnid. Small amounts of suspended material seem to be essential to the optimal survival and reproduction of D. magna so that in dilute suspensions a beneficial effect was noted with all materials tested. This effect appeared to be unrelated to the adsorptive capacities of the suspensions, whereas at higher levels some suspensions had a toxic effect which was apparently related to their adsorptive capacities. Charcoal (tested at levels up to 102 ppm) and montmorillonite (154 ppm), the most adsorptive materials studied, were toxic at approximately 100 ppm; ground glass (98 ppm), India ink (676 ppm), kaolinite (392 ppm), chlorite (120 ppm), illite (264 ppm), and pond sediment, in which kaolinite, vermiculite (?), illite, and quartz were identified by x-ray diffraction (1458 ppm), were not toxic at any of the tested levels. Washing in HCl increased the toxicity of adsorptive materials, montmorillonite, charcoal, and pond sediment, but did not increase the toxicity of glass or kaolinite.

The turbidity of a typical North Carolina farm pond was found to vary over the range of concentrations 30—201 ppm which were shown to be beneficial and toxic in turbidity experiments. The plankton dominants Eudorina sp. and Daphnia pulex were measured over the same spring period during which the turbidity fluctuation was studied. (Auth. summ.)

1160. Bullock, Wilbur L. 1957. THE ACANTHOCEPHALAN PARASITES OF THE FISHES OF THE TEXAS COAST. Publs. of the Inst. of Mar. Sci., Vol. 4, No. 2, July, pp. 278-283.

In the course of a histochemical study of the Acanthocephala during 1955-56, 1,264 fish from the coastal waters of Texas, representing 39 species, were examined for Acanthocephala. These fish, for the most part, were seined on the open Gulf beach or in the tidal creeks and pools. A few fish were taken by hook and line and one batch was received from local fishermen in Galveston Bay. Seven species representing four families and including one new genus and species were found during the course of these collections.

1161. Knott, S. T. and J. B. Hersey. 1956. INTERPRETATION OF HIGH-RESOLUTION ECHO-SOUNDING TECHNIQUES AND THEIR USE IN BATHYMETRY, MARINE GEOPHYSICS, AND BIOLOGY. Deep-Sea Res., Vol. 4, Dec., pp. 36-44.

Experience in making observations with commercially available correlation recorders designed for sounding ocean depths has suggested design modifications which would combine the capabilities of both shallow- and deep-water sounders in one instrument as well as improve their general performance for research. The design and construction of such a recorder is described. Some examples are given of its application to the study of smaller-scale bottom features; to the echolocation of fish schools, individual fishes, and other aggregations of marine animals; and for locating instruments in depth and range.

Occasionally echo-sounder pings penetrate the bottom to reflect from deeper horizons; the recorder then presents a continuous-structure section. By using a sound source having a broad spectrum instead of the usual single-frequency ping, and by extending the receiver design to record in two or more filter bands, shallow structures have been observed which could not be recorded with the high frequency of the conventional echo sounder. (Auth. abstr.)

1162. Cochrane, John D. 1956. THE FREQUENCY DISTRIBUTION OF SURFACE-WATER CHARACTERISTICS IN THE PACIFIC OCEAN. Deep-Sea Res., Vol. 4, Dec., pp. 45-53.

The frequency distributions of surface-water characteristics in the Pacific Ocean are presented in a series of temperature-salinity diagrams. The frequencies are estimated from maps of mean surface temperature and salinity in February and August. Six twodimensional distributions are obtained, one each for February, August, and the year in the North Pacific, and one for each of these periods in the South Pacific. Prominent features of the distributions are discussed. (Auth. abstr.)

1163. Zenkevich, L. A. and J. A. Birstein. 1956. STUDIES OF THE DEEP WATER FAUNA AND RELATED PROBLEMS. Deep-Sea Res., Vol. 4, Dec., pp. 54-64.

Investigations on the Kuril Trench, carried out in 1953 by the Soviet expedition on the Research Ship Vitjaz allowed several general principles to be laid down in the change of the bottom and the pelagic faunas with increasing depth.

The biomass of benthos and plankton in the ultra-abyssal zone (>6,000 m) is 1,000 times less than in the surface zone. With the increase of depth the variety of species of benthos decreases; its diversity increases at first and then decreases, for the most part within the ultra-abyssal zone.

The colouring change of bottom and pelagic animals also takes place differently according to depth. Many pelagic animals are pigmented up to depths of 6-7,000 m. Only the plankton of the ultra-abyssal zone is totally devoid of pigment (except the amphipad Andaniexis subabyssi Birst. et M. Vin.). The bottom animals become pigmentless, at depths greater than about 2,000 m. Possibly this dissimilarity is due to vertical migrations of broad range peculiar to pelagic animals.

The relative importance of predators of plankton increases with depth. This contrasts with the bottom animals, for which there is an increase in relative importance of detritus eaters and a lesser importance of predators at increasing depths.

One of the many sources of food supply for the abyssal and ultra-abyssal fauna is provided by the transportation of organic matter from the zone of photosynthesis down to the great depths by means of vertical migration of zooplankton, performed either within each fixed vertical zone, or having a still broader range. During their vertical migrations

the upper layers of deep-sea animals become the prey of the lower dwellers and thus the organic matter produced in the zone of photosynthesis is brought to the greatest depths of the ocean.

The body-size comparison of species of the same genus inhabiting different depths shows a tendency to greater body-size with greater depth. This is true for both bottom and pelagic animals. It cannot be explained by temperature changes.

The deep-sea fauna comprises a great quantity of ancient and primitive forms. The zoogeographic regions of the ocean ought to be determined from separate vertical zones. In addition, the determination of zoogeographic regions of the abyssal zone will show not only the connections and the hydrological regime of the contemporary seas and oceans but also those of the seas and oceans of the remote past.

The ultra-abyssal faunas of each trench must comprise endemic species or even units of a higher taxonomic grade. A set of these species was discovered in the extreme depths of the Kuril Trench. (Auth. abstr.)

1164. Laughton, A. S. 1957. A NEW DEEP-SEA UNDERWATER CAMERA. Deep-Sea Res., Vol. 4, No. 2, April, pp. 120-125.

A deep-sea underwater camera containing several new design features is described. It is capable of taking up to a hundred pictures at one lowering in depths up to 5,000 m. Some examples of its use in biological and geological surveys of the ocean floor are presented. (Auth. abstr.)

1165. Marr, John C. 1957. CONTRIBUTIONS TO THE STUDY OF SUBPOPULATIONS OF FISHES. U. S. Fish and Wildlife Service, Dept. of the Interior, Spec. Sci. Rep.--Fish. No. 208, April, 129 pp.

This is a collection of 11 papers, actually a written symposium, on the title subject. Abstracts numbered 1166 to 1175 cover these papers.

1166. Marr, John C. 1957. THE PROBLEM OF DEFINING AND RECOGNIZING SUBPOPULATIONS OF FISHES. U. S. Fish and Wildlife Service, Dept. of the Interior, Spec. Sci. Rep.--Fish., No. 208, April, pp. 1-6.

A somewhat introductory article to this symposium publication, in which the terms population, subpopulation, stock, group, and race are defined; subpopulation study methods are reviewed; and recent advances in methodology are discussed. As coordinator of the publication, the author concludes that first, there appears to be a reasonably widespread realization that the classical meristic-morphometric approach alone will not lead to a satisfactory and conclusive solution of this problem; second, and perhaps as a corollary of the first, the genetic implications of this problem are coming to be more generally realized and accepted; third, there seems to be more effort devoted to developing new and more satisfactory tools and to borrowing and adapting pertinent tools from other fields; fourth, the desirability of a direct attack (tagging) on this problem is being recognized by more and more individuals; and finally, and perhaps to a lesser extent, the applicability of the experimental method to problems in the field is being appreciated.

1167. Marr. John C. 1957. STATISTICAL COMPARISON OF MORPHOLOGICAL DATA. U. S. Fish and Wildlife Service, Dept. of the Interior, Spec. Sci. Rep.--Fish., No. 208, April, pp. 7-28.

This paper considers the relative merits of the test of significance and the measurement of overlap, discusses how to determine overlap of counted characters and how to find the overlap of measured characters through regression analysis, and shows the relation between overlap and a concept of the distance between the means and the application of a generalized distance function to measure simultaneously the overlapping of several characters. Sampling problems and the importance of specifying the bounds of the sampled population are stressed, together with the pitfalls to be avoided in an evaluation of intermingling from morphological studies and tag returns.

1168. Widrig, T. M. and Bruce A. Taft. 1957. MEASUREMENT OF POPULATION MOVEMENT BY OBSERVATION OF MERISTIC OR MORPHOMETRIC CHARACTERS. U. S. Fish and Wildlife Service, Dept. of the Interior, Spec. Sci. Rep.--Fish., No. 208, April, pp. 29-34.

One of the persistent problems of fishery biology has been the determination of movement of fish within a population occupying a given geographical area. A method for estimation of the amount of interchange between sub-areas based on the time differences in mean values of attributes of the fish is proposed. Since mixing is a dynamic process, conclusions about its magnitude must be based upon observations taken in succeeding time periods.

The true difference in an attribute's mean between time periods of a region subject to migration from an adjacent area depends on both the difference in means of the mixing fish and the extent of the migration into the region. Providing first that the migrating fish are representative of the fish in the adjacent area, second, that the attribute is constant with the passage of time, and third, that the change in mean between years may be solely attributed to mixing from a given adjacent region, then a simple method of estimating the magnitude of mixing has been presented. Confidence limits for an estimate of the proportion of fish in the local region that have moved from the adjacent region are included. It is important to remember that this technique will not yield an estimate unless real differences in the two regions' means are established. For this reason consideration should be given to the number of fish sampled from the regions, and they should be taken in such a manner that the samples are representative of the fish populations.

The main difficulty in application of the method lies in establishing the source of immigrants, and the usefulness of tagging data in this regard has been described. (Auth. summ.)

1169. Farris, David A. 1957. A REVIEW OF PAPER CHROMATOGRAPHY AS USED IN SYSTEMATICS. U. S. Fish and Wildlife Service, Dept. of the Interior, Spec. Sci. Rep.--Fish. No. 208, April, pp. 35-38.

Chromatography, a technique for separating the components of a complex mixture, is based on the differential adsorption and solvation of the components. A small quantity of the mixture to be separated, in this case either body fluid or tissue extracts, is placed on a spot not over a quarter of an inch in diameter near one edge of a filter paper sheet. After the spot is dry, the edge of the filter paper is dipped into a solvent so that the solvent flows over the spot by capillarity. As the solvent front progresses over the paper, the components of the mixture are spread out behind the front in discrete areas. To stop the process, one merely removes the solvent and allows the paper to dry. By the use of indicator solutions, ultra violet light, etc., the spots are located for identification. The compounds can be removed from the filter paper by elution and the amounts determined quantitatively.

Use of this technique in systematics is based on the assumption that the greater the number of enzyme systems held in common by different populations, the closer their phylogenic relationship. This work is in a very elementary and exploratory phase. Theoretically, it holds great promise in the investigation of subspeciation where the magnitude of variation is reduced and harder to assess.

1170. Ridgway, George J. 1957. THE USE OF IMMUNOLOGICAL TECHNIQUES IN RACIAL STUDIES. U. S. Fish and Wildlife Service, Dept. of the Interior, Spec. Sci. Rep.--Fish., No. 208, April, pp. 39-43.

Whenever studied, the blood cell antigens have been shown to be genetically controlled. Variations in environment do not affect the blood type. The frequencies of occurrence of genes controlling cellular antigens have been found to differ significantly between races of man and between breeds of cattle. By means of these frequencies, races may be characterized or defined.

Once sufficiently potent antisera are prepared, the test for blood cell antigens is a relatively simple operation which could be carried out in the field or on board ship. Commercially caught fish could be tested for their complement of blood cell antigens without damage to their commercial value since only a small amount of blood is required. In addition, when unit serological reagents have been prepared, they would be of value as markers in studying the genetics of fish, the migration of fish and the precision of their homing abilities. (Auth. concl.)

1171. Ahlstrom, Elbert H. 1957. A REVIEW OF RECENT STUDIES OF SUBPOPULATIONS OF PACIFIC FISHES. U. S. Fish and Wildlife Service, Dept. of the Interior, Spec. Sci. Rep.--Fish., No. 208, April, pp. 44-73.

This paper reviews research on "subpopulations" of eight Pacific fishes. The species dealt with are the Pacific herring, yellowfin tuna, albacore, Pacific mackerel, northern anchovy, anchovetta, nehu, and Australian anchovy.

In none of the studies were the workers able to distinguish between differences induced by the environment and those which had a genetical basis. Hence, the workers were dealing with "groups" as defined by Marr, rather than with "subpopulations" and "stocks". For all species, the indirect approach has been utilized (meristic and/or morphometric characters), and for five of the species some tagging has been done. However, for only two species has tagging been extensive enough to be of value in subpopulation studies, i.e., Pacific herring and Pacific mackerel.

In studying subpopulations of clupeid and engraulid fishes, most workers have relied on meristic characters, especially vertebral counts. In studying subpopulations of scombroid fishes (tunas and mackerels), on the other hand, meristic characters have shown too little variation to be of value, hence techniques have been developed for utilizing morphometric characters.

For all species studied it has been possible to show "population heterogeneity". However, it has not been possible to determine the extent of separateness of the various parts of a population by the indirect approach. Even such advances in this field as the "concept of overlap" discussed in the paper by Royce do not entirely resolve this difficulty. For determining the extent of intermingling there appears to be no substitute for effective tagging experiments. (Auth. summ.)

1172. Raney, Edward C. 1957. SUBPOPULATIONS OF THE STRIPED BASS ROCCUS SAXATILIS (WALBAUM), IN TRIBUTARIES OF CHESAPEAKE BAY. U. S. Fish and Wildlife Service, Dept. of the Interior, Spec. Sci. Rep.--Fish., No. 208, April, pp. 85-107.

On the basis of meristic studies which are supported by findings of earlier tagging experiments, it is concluded that three subpopulations are present within the tributaries of Chesapeake Bay. The James River subpopulation is best defined. The other two are the York-Rappahannock subpopulation and the Upper Bay subpopulation.

The number of first dorsal spines is fairly constant in samples from two year classes taken throughout a wide geographic range in both the James and Hudson Rivers; this appears to indicate little effect by environmental fluctuations. The James subpopulation has high values for the dorsal spines and is statistically different from other populations in Chesapeake Bay and elsewhere along the Atlantic Coast including the population in Albemarle Sound, North Carolina.

Soft dorsal and anal rays show a slight but significant increase in downstream samples in the Hudson River. This may be a reflection of temperature and/or salinity differences. In the James River, downstream increases in dorsal and anal rays are not statistically significant. The James subpopulation is significantly different from the adjacent York-Rappahannock subpopulation and from the Upper

Bay subpopulation in having lower values for soft dorsal rays and soft anal rays.

The York-Rappahannock subpopulation differs from the Upper Bay subpopulation in second dorsal soft rays but these subpopulations are not as highly differentiated as are those of the James and York-Rappahannock. Both the Hudson and James populations approach and differ from other Chesapeake Bay tributaries in having a high dorsal spine count and low dorsal soft and low anal soft ray counts, but they are significantly different. This supports the former meristic and tagging studies which regarded the Hudson and Chesapeake populations as separate races.

Where several characters are correlated the meristic or character index, in this instance the dorsal spines minus the sum of the anal and dorsal soft rays, continues to be a useful technique in separating populations. (From auth. summ.)

1173. Marr, John C. 1957. THE SUBPOPULATION PROBLEM IN THE PACIFIC SARDINE SARDINOPS CAERULEA. U. S. Fish and Wildlife Service, Dept. of the Interior, Spec. Sci. Rep.--Fish. No. 208, April, pp. 108-120.

The subpopulation problem in the Pacific sardine is concerned with the number and identity of genetically self-sustaining units within the population. Evidence of many kinds shows that there are between- and within-season, port and year-class differences. This evidence includes migration, growth, meristic characteristics, etc. It is not known whether these differences are phenotypic or genotypic; however, the weight of the evidence is that they are phenotypic.

There are three possible methods of estimating the exchange between space-time spawning areas. Samples could be collected from several spawning grounds and these could be examined to determine any area-specific morphological or meristic differences; the question of whether these are genotypic or phenotic remains unsolved, however. Characteristics could be picked which are known to be genotypic, or which can be determined experimentally to be genotypic, and samples from several spawning grounds could be examined; the extent to which a characteristic is genotypically controlled is unknown. Tagging and tag recovery on the spawning grounds offers the third possibility. Of the three, the tagging-experiment will yield the most direct evidence and may have to be resorted to eventually. Tagging experiments, however, are large and costly undertakings. It is more realistic to critically assess the possibilities of chromatography and immunology before deciding in favor of a tagging experiment.

A tagging experiment design is included as an appendix.

1174. Snieszko, S. F. 1957. DISEASE RESISTANT AND SUSCEPTIBLE POPULATIONS OF BROOK TROUT (SALVELINUS FONTINALIS). U. S. Fish and Wildlife Service, Dept. of the Interior, Spec. Sci. Rep.--Fish. No. 208, April, pp. 126-128.

There is the general agreement that disease resistance is a genetic characteristic. In view of this and the experimental findings of several workers who tested disease resistances of various hatchery stocks, it is reasonable to classify as populations, or at least subpopulations, those hatchery stocks exhibiting significantly different degrees of susceptability to infectious diseases.

1175. Eschmeyer, Paul H. 1957. NOTE ON THE SUBPOPULATIONS OF LAKE TROUT IN THE GREAT LAKES. U. S. Fish and Wildlife Service, Dept. of the Interior, Spec. Sci. Rep.--Fish. No. 208, April, p. 129.

The subpopulations of lake trout, in Lake Superior at least, are clearly real. Characteristic spawning seasons and localities vary widely effecting genetic isolation in part; tagging studies revealed a marked tendency of adults to return year after year to the same spawning grounds. Wide variation occurs in size at sexual maturity. A large difference in fat content of lake trout and the subspecific siscowets has been demonstrated. The significance to management of the existence of these subpopulations is great.

1176. Gangmark, Harold A. 1957. FLUCTUATIONS IN ABUNDANCE OF COLUMBIA RIVER CHINOOK SALMON 1928-54. Fish and Wildlife Service, U. S. Dept. of the Interior, Spec. Sci. Rep.--Fish. No. 189, July, 21 pp.

The U. S. Fish and Wildlife Service is legislatively charged by the Coordination Act of 1934 as amended August 14, 1946, to investigate Federal water-use influence on the fishery and to provide for the protection of these resources. This is an evaluation of the Bonneville Dam influence on chinook salmon population in the Columbia River based on the availability of the fish to the gill nets.

Breaking the fishing year into spring, summer and fall components, return estimates based on the periods before and after construction of the dam show mixed trends. The spring returns are better after dam construction, the summer returns are far worse, and the fall returns balance. Ratios of return to escapement for the three seasons of the year show a spring improvement after dam construction, a large drop in summer, and a lesser drop in the fall. Return-to-escapement ratio levels after Bonneville Dam appear related to the proportion of chinooks which pass Bonneville Dam as adults and again as juveniles. For example, all summer chinooks spawn above Bonneville Dam while roughly two thirds of the spring chinooks spawn above the dam. On the other hand, the annual abundance curve reveals no change in trend before and after dam construction and the mixed trends of spring, summer, and fall seasons do not appear influenced by the construction date of Bonneville Dam. (Auth. abstr.)

1177. Powell, Donald E. and Alvin E. Peterson. 1957. EXPERIMENTAL FISHING TO DETERMINE DISTRIBUTION OF SALMON IN THE NORTH PACIFIC OCEAN, 1955. Fish and Wildlife Service, U. S. Dept. of the Interior, Spec. Sci. Rep.--Fish.

No. 205, July, 30 pp.

Distribution of salmon on the high seas in the North Pacific Ocean was investigated by the U. S. Fish and Wildlife Service during the summer and early fall of 1955. Three vessels conducted extensive gill-net operations over a 3 1/2-month period in the Gulf of Alaska and in the offshore waters south of the Aleutian Islands and the Alaska Peninsula, with a limited amount of fishing off the coasts of Oregon, Washington, and British Columbia. Results showed that the several species of North American salmon and the steelhead trout were widely distributed in the open ocean at that time of year and could be sampled readily with surface gill nets.

Salmon were caught at all stations occupied from off northern Vancouver Island across the Gulf of Alaska as far west as Unalaska Island. Catches farther west and in more southerly waters revealed an apparent southern limit for high-seas salmon at about 47° N. latitude in the area of major operation. South of this line in the warmer waters albacore replaced salmon in the gill-net catches.

Length measurements of all salmon were taken aboard the vessels and are presented graphically according to species and by mesh size. (Auth. abstr.)

1178. Ahlstrom, Elbert H. and David Kramer. 1957. SARDINE EGGS AND LARVAE AND OTHER FISH LARVAE PACIFIC COAST, 1955. Fish and Wildlife Service, U. S. Dept. of the Interior, Spec. Sci. Rep.--Fish. No. 224, July, 90 pp.

This report contains the results of quantitative sampling of fish eggs and larvae off the coasts of California and Baja California during 1955. The eggs and larvae are sampled in quantitative plankton hauls taken over a grid of stations that usually are occupied at monthly intervals.

Eggs and larvae are reported for the Pacific sardine (Sardinops caerulea), and larvae alone for the northern anchovy (Engraulis mordax), jack mackerel (Trachurus symmetricus), Pacific mackerel (Pneumatophorus diego), hake (Merluccius productus) and rockfish (Sebastodes spp.). The report includes charts showing the distribution and relative abundance in 1955 of each of the above species, except rockfish, and brief descriptive accounts of each. (Auth. abstr.)

1179. Lewis, Robert Minturn. 1957. COMPARATIVE STUDY OF POPULATIONS OF THE STRIPED BASS. Fish and Wildlife Service, U. S. Dept. of the Interior, Spec. Sci. Rep.--Fish. No. 204, June, 54 pp.

This study was undertaken in an effort to determine the value of gill raker counts as a taxonomic tool in classifying populations of striped bass, Roccus saxatilis. The possibility of a change with age and a difference between sexes in the number of gill rakers was investigated. Specimens were available from Philip River, Miramichi River, St. Lawrence River, coastal Rhode Island, Long Island Sound, Hudson River, Mullica River, Delaware River, Chesapeake Bay, Albemarle Sound, Pamlico River, Cape Fear River, Santee-Cooper River System, Gulf of Mexico, and California. Gill raker counts were subjected to the following statistical procedures: t-test, analysis of variance, analysis of covariance, chi-square and regression. The tests showed that there was no change in the number of gill rakers in the first two years of growth and that there was no significant difference in the number of gill rakers between males and females. On the basis of gill raker counts only, specimens from the Santee-Cooper River System, South Carolina were considered as one population; this was also true for specimens from the Hudson River, New York. The Chesapeake Bay population was divided into three main subpopulations. Samples from Long Island Sound were intermediate between those of Chesapeake Bay and the Hudson River. Specimens from California and the Hudson River had high counts and those from the Delaware River approached those from the James River in the Chesapeake Bay. It was shown that gill raker counts could be used to separate populations of striped bass. (Auth. abstr.)

1180. Tully, John P. and Alan J. Dodimead. 1957. PROPERTIES OF THE WATER IN THE STRAIT OF GEORGIA, BRITISH COLUMBIA, AND INFLUENCING FACTORS. J. of the Fish. Res. Bd. of Can., Vol. 14, No. 3, May, pp. 241-319.

The temperature, salinity, pH, and concentrations of dissolved oxygen, dissolved nitrates, nitrites, inorganic phosphates, and silicates are shown and discussed. The occurrence of these properties and their seasonal and diurnal cycles are related to the mechanism of tidal exchange, discharge of the Fraser River, weather, and growth of plankton to show the sources of the properties, the sequence of their change, and why, when, where, and how they occur.

In the Strait of Georgia the waters are highly stratified. Fresh water from the Fraser River moves persistently seaward, entraining sea water en route. An upper brackish zone is formed in which the constituents occur in cloud-like distribution, and vary with tide and season. Below this is a deep zone where stratification is slight, and the properties are nearly constant throughout the area and the year.

In the approaches to the strait the tidal flows are turbulent and mix the waters to homogeneity. Here the highly stratified upper-zone waters became apparent during the ebb flow, and homogeneous waters during the flood.

The high concentrations of dissolved phosphates are attributed to the ocean water which intrudes the region in the lower zone. The high concentrations of dissolved silicates are attributed to the Fraser River waters. It is suggested that the supply of dissolved nitrates is the limiting factor in phytoplankton growth. (Auth. abstr.)

1181. Waldichuck, Michael. 1957. PHYSICAL OCEANOGRAPHY OF THE STRAIT OF GEORGIA, BRITISH COLUMBIA. J. of the Fish. Res. Bd. of

Can., Vol. 14, No. 3, May, pp. 321-486.

A descriptive and quantitative analysis of the physical oceanography of the Strait of Georgia has been made.

The area has been characterized by extreme seasonal and regional variability of the surface waters. Deep water undergoes only small change. Runoff, principally from the Fraser River, is the major cause of salinity variation. Surface warming by insolation is reflected in high summer surface water temperatures in the Central and Northern Strait.

Analysis of the Strait of Georgia has been based on a hypothetical model of a deep, rectangular basin connected to the sea by mixing baffles and a long channel. Fresh water inflow is concentrated near the southern end of the basin. The Strait of Georgia-Juan de Fuca Strait system has basically three water masses: (1) the brackish surface water from runoff in the Strait of Georgia; (2) the deep water of oceanic origin in Juan de Fuca Strait; and (3) a mixture of (1) and (2) which forms at the sills. This mixture contributes to the deep water in the Strait of Georgia and to the upper seaward-flowing layer in Juan de Fuca Strait. Bottom water is formed in late autumn when dense sea water from Juan de Fuca Strait intrudes into the mixing area of the southern sills. An intermediate water is formed during some cold winters in the Northern Strait. A slow intrusion of warm intermediate water occurs from the southern sills in late summer.

A general counter-clockwise circulation exists in the Strait of Georgia, tides, runoff, and winds are the principal generating forces. Topography, Coriolis force, and centrifugal force are the main directive factors. Circulation has been studied from drift bottle experiments, mass distribution, and isentropic analysis.

Some of the effects of winds in mean sea level changes and surface currents have been evaluated. Wind effects are most pronounced in influencing the circulation of the upper brackish layer.

Waters are most stable in the Central and Northern Strait. Intensive tidal mixing renders the waters of the Southern Strait nearly homogeneous, particularly in winter. The largest amount of mixing energy comes from the tide, but winds contribute substantially to mixing in the surface water. The potential energy change from a stratified to a mixed column of water in the Southern Strait has been computed. Keulegan's criterion of mixing is applied to the system at the Fraser River estuary.

A technique for determining the fresh water budget in the Strait of Georgia has been developed. This has been evaluated on the basis of the 1950 meteorological, hydrological, and oceanographic data. At a particular time there is a volume of fresh water in the Strait of Georgia equivalent to 1 1/3 years of Fraser River discharge based on an average salinity of 33.8 percent in the inflowing oceanic water. Little effect in the overall fresh water content of the system is caused by sudden increases or decreases in the runoff.

The heat budget based on five stations where the necessary meteorological and oceanographic data were available has been evaluated for 1950. Considerable variation in evaporation is largely dependent on the variation in surface water temperature. Peak evaporation occurs in the Southern Strait in late autumn with negative (condensation) values in late summer. Maximum evaporation occurs in mid-summer in the Central and Northern Strait. On a yearly basis, there is a loss of heat from the system through the transport seaward of surface water.

Some concepts of inshore oceanography are given with general guiding principles for the planning and conduct of surveys. (Auth. abstr.)

1182. Van Oosten, John and Hilary J. Deason. 1957. HISTORY OF RED LAKES FISHERY, 1917-38, WITH OBSERVATIONS ON POPULATION STATUS. Fish and Wildlife Service, U. S. Dept. of the Interior, Spec. Sci. Rep.--Fish. No. 229, Aug., 63 pp.

A historical account traces the development of the commercial fisheries of the Red Lakes, Minnesota, from its inception in 1917 as a war measure through 1938. The trends of production and catch per unit of effort were followed for the principal species with notes on statistics of the minor fishes. Life history data were recorded for the walleye and yellow perch. A historical account was presented of the artificial propagation of the walleye and whitefish from 1918 through 1938. (Auth. abstr.)

1183. Bardach, John E. 1956. THE SENSITIVITY OF THE GOLDFISH (CARASSIUS AURATUS L.) TO POINT HEAT STIMULATION. The Amer. Nat., Vol. 90, No. 854, Sept.-Oct., pp. 309-317.

By conditioned reflex training it was found that goldfish sense ambient temperature increments of about .1° C. over their entire body surface. Even the fins bear warm sensitive nerve endings. The receptors apparently operate on the principle of areal summation with an instantaneous heat increment of 2° C. as the lower limit to which a fish would react when an area of 2 sq. mm. was stimulated with heated probes after it had been trained not to react to touch stimuli.

An estimate of the total number of units involved in relative temperature discrimination suggested that several thousand units are involved; this number is of a comparable order of magnitude to that found in other vertebrates with a similarly fine or finer level of heat discriminatory capacity. This order of magnitude of unit receptors is found, whether collected in special organs or scattered over the entire body surface. (Auth. summ.)

1184. Wood, Raymond A. and John D. Mizelle. 1957. STUDIES ON MONOGENETIC TREMATODES XXI. NORTH AMERICAN GYRODACTYLINAE, DACTYLOGYRINAE AND A NEW HOST RECORD FOR UROCLEIDUS DISPAR (MUELLER, 1936). The Amer. Midland Nat., Vol. 57, No. 1, Jan., pp. 183-202.

Seven new species of Gyrodactylus and four new species of Dactylogyrus are described from gills of

fishes from British Columbia, California, Indiana, Michigan, Nevada, and Texas. Urocleidus dispar (Mueller) Mizelle and Hughes (1938) is comparatively described because of its occurrence on Archoplites interruptus (Girard) the only native centrarchid west of the Rocky Mountains, which constitutes a new host record. A table of Gyrodactylus species and the different hosts infested by each, shows that 78.2 percent infest 1 host each, 6.89 percent infest 3 host species, and 3.44 percent infest each of 2, 6, 7, 9, and 19 different host species. This data shows that the host specificity among the Gyrodactylinae is much more limited in the Dactylogyrinae (Monaco and Mizelle 1955).

A standard terminology for description of Gyrodactylus species is proposed. The subspecific categories of Gyrodactylus erected by Yin and Sproston (1948) are hereby rejected for lack of adequate studies on this group. The genus Neodactylogyrus Price, 1938, is considered invalid. North American species of Gyrodactylus are listed with the hosts infested and other pertinent data. (From auth. summ.)

1185. Gordon, Malcolm S. 1957. OBSERVATIONS ON OSMOREGULATION IN THE ARCTIC CHAR (SALVELINUS ALPINUS L.). The Biol. Bull., Vol. 112, No. 1, Feb., pp. 28-33.

Adult Arctic char (Salvelinus alpinus), taken in summer from Hebron Fjord, Labrador, and Hudson Bay near Churchill, Manitoba, were transferred directly from salt to fresh water under fairly constant conditions. Decreases in blood freezing point and chloride concentration of the order of 25 percent were found, the char thus being like most other anadromous salmonids in this respect. The possibility of much better regulation of muscle concentrations is indicated.

Data are presented on plasma freezing point, chloride, and potassium, muscle solids, chloride, and potassium. Physiological differences between populations of char are indicated. (Auth. summ.)

1186. Meuwis, A. L. and M. J. Heuts. 1957. TEMPERATURE DEPENDENCE OF BREATHING RATE IN CARP. The Biol. Bull., Vol. 112, No. 1, Feb., pp. 97-107.

The dependence of the frequencies of respiratory movements upon temperature has been studied in Cyprinus carpio L. The degree of dependence of these frequencies upon temperatures is primarily determined by the size of the fishes. Large fishes are highly, small fishes only slightly, dependent. Small fishes are characterized by a broad homeostatic zone of independence of the breathing frequency on temperatures. This homeostatic zone disappears in large fishes. The upper lethal temperatures decrease concomitantly with the disappearance of the homeostatic zones. Individual variants, as to the degree of homeostasis and as to the adaptive temperature ranges, can be detected by the method presented. It can be used for studying genetic determination of these characteristics. A survey of the data in the literature allows one to distinguish poikilotherms with progressive and with regressive ontogenies, with respect to homeostatic behavior. (Auth. summ.)

1187. Boroughs, Howard, Sidney J. Townsley and Robert W. Hiatt. 1956. THE METABOLISM OF RADIONUCLIDES BY MARINE ORGANISMS. I. THE UPTAKE, ACCUMULATION, AND LOSS OF STRONTIUM^{89} BY FISHES. The Biol. Bull., Vol. 111, No. 3, Dec., pp. 336-351.

Radiostrontium^{89} was chosen over Sr^{90} for these studies as it has a half life of about 53 days compared to 28 years for the latter. The ingestion of Sr^{89} by large pelagic fishes results in the excretion of most of the isotope in a few hours. The small percentage remaining after one day persisted for the 27 days of the experiment. The strontium is rapidly eliminated from the visceral organs and tissues, but the structural tissues, including the bones, gills, integument and muscle, maintain their strontium level more or less constant. The turnover of strontium in these latter tissues is therefore slow. Dark muscle, which has a better blood supply than light muscle, retains less Sr^{89}. Similarly, bone, which is better supplied with blood than is cartilage, retains less Sr^{89} than the gill arches or the cartilaginous eye ossicles. The excretion of Sr^{89} by Tilapia mossambica is much slower than it is by the pelagic fishes. The percentage of the dose retained is somewhat larger, and most of the radioactivity is found in the structural tissues.

About three times as much Sr^{89} was found in the muscle of an injected tuna as compared with another fish receiving the isotope orally. The gills of the former fish had only about half the activity found in the latter. From 60-70 percent of the dose injected into Tilapia muscle was retained by these fish for 14 days. The long biological half-life of of Sr^{89} in fish muscle is contributing evidence for the slow turnover of muscle tissue in comparison with such tissues as liver or kidney. Tilapia were able to concentrate Sr^{89} directly from the sea water, although the ratio of Sr^{89} in the fish to the Sr^{89} in an equal weight of sea water was only about 0.3 after three weeks. Except for the visceral organs, the rank order of the retention of radioactivity in the various tissues is skeleton, integument, gills and muscle. This is the same distribution as was observed after oral administration of Sr^{89}. Because marine fish swallow water continually, a small amount of water in the gut might account for the relatively large percentage of radioactivity found in the viscera. (Auth. summ.)

1188. Boroughs, Howard, Sidney J. Townsley and Robert W. Hiatt. 1956. THE METABOLISM OF RADIONUCLIDES BY MARINE ORGANISMS. II. THE UPTAKE, ACCUMULATION, AND LOSS OF YTTRIUM^{91} BY MARINE FISH, AND THE IMPORTANCE OF SHORT-LIVED RADIONUCLIDES IN THE SEA. The Biol. Bull., Vol. 111, No. 3, Dec., pp. 352-357.

A study of the metabolism of radioyttrium is important for two reasons: first, yttrium^{90} occurs as the daughter of long-lived strontium^{90}, an element

which has considerable interest from the standpoint of public health, and second, yttrium^{91} occurs as a direct fission product to the extent of about 4 percent of the total radioactivity present in a fission product mixture one year old.

Only about 2 percent of an ingested dose of yttrium^{91} was left in Tilapia mossambica after two days. This is much less than the amount of strontium retained by Tilapia in similar experiments. About 40 percent of the radioisotope remaining is found in the visceral organs, but the muscles retain about 30 percent after 14 days. The skeleton retained less than 20 percent, the integument about 10 percent, and the gills 5 percent. These findings are in marked contrast with those obtained with strontium^{89} in similar experiments. Attention is focused on the fact that yttrium^{91} may have little direct effect on man compared with the possible effects of Sr^{90}, but the retention of this and other short-lived fission products in marine organisms having a brief life span may possibly affect the biota, and thus affect man indirectly. (Auth. summ.)

1189. Kennedy, Donald and Roger D. Milkman. 1956. SELECTIVE LIGHT ABSORPTION BY THE LENSES OF LOWER VERTEBRATES, AND ITS INFLUENCE ON SPECTRAL SENSITIVITY. The Biol. Bull., Vol. 111, No. 3, Dec., pp. 375-386.

Spectrophotometric studies of fresh intact lenses from a variety of fish and from frogs have shown that they are steep cut-off fibers of ultra-violet radiations, selectively absorbing almost all light of wave-length shorter than 400 mμ. Certain species of fish possess lenses having high transmission in the near ultra-violet, between 320 and 400 mμ; these species must be sensitive to this spectral region, since visual pigments absorb there. Lenses of the butterfish show a steep cut-off at about 350 mμ.

There appears to be a correlation between possession of ultra-violet filtering lenses and a requirement for acute vision, supporting the idea that they aid visual acuity by eliminating wavelengths which produce severe chromatic aberration. Such lenses, however, cannot be regarded as functionally equivalent to such intra-ocular carotenoid filters as retinal oil droplets and macula lutea since they absorb in quite different spectral regions. The theory that lens filters are an evolutionary "replacement" for oil droplets in secondarily diurnal animals is thus not in agreement with these findings.

Substances responsible for the properties of these lenses as filters have been extracted with water from the lens tissue. Lenses which cut off at 400 mμ yield a substance with an ultra-violet absorption maximum at 360 mμ; those of the butterfish, which cut off at 350 mμ, yield a substance with maximum absorption at 320 mμ. A presumed oxidation product of 360-pigment has been obtained which is spectrally similar to 320-pigment from the butterfish. Both substances have been characterized as to solubility, ultra-violet absorption spectra, and chromatographic behavior, but no definite identification has been made. (From auth. summ.)

1190. Moulton, James M. 1956. INFLUENCING THE CALLING OF SEA ROBINS (PRIONOTUS SPP.) WITH SOUND. The Biol. Bull., Vol. 111, No. 3, Dec., pp. 393-398.

A vibrant grunt and a staccato call of sea robins in the Woods Hole area are described. Sounds similar to these can be obtained by manipulation of the air bladder and by stimulation of the nerves to the drumming muscles. It is suggested that the sea robin grunt is part of a general alarm reaction, and that the staccato call is related to the breeding behavior of the sea robin. It is suggested that the staccato call may serve as a species recognition device in waters where visibility is relatively poor. A method of controlling production of the staccato call is described. Production of the call can be initiated by playing into the water imitations of the call and recordings of the call itself. The calling can be suppressed by playing of signals of 200 to 600 cps, and, less consistently, by playing of signals of 600 cps to 2 kc. The results obtained furnish an exception to the general rule that sound production causes only quickened swimming movements of free fishes, and demonstrate the possibility of exercising some degree of control over the behavior of fishes in nature with man-made sounds. (Auth. summ.)

1191. Pitt, T. K., E. T. Garside, and R. L. Hepburn. 1956. TEMPERATURE SELECTION OF THE CARP (CYPRINUS CARPIO LINN.). Can. J. of Zool., Vol. 34, No. 6, Dec., pp. 555-557.

The selected or preferred temperatures of the carp were determined for six acclimation temperatures. At 10° C., 15° C., 20° C., 25° C., 30° C., and 35° C. acclimation the selected temperatures were 17° C., 25° C., 27° C., 31° C., 31° C., and 32° C., respectively. The final preferendum of carp was found to be 32° C. (Auth. abstr.)

1192. Margolis, L. and James R. Adams. 1956. DESCRIPTION OF GENOLINEA ONCORHYNCHI N. SP. (TREMATODA: HEMIURIDAE) FROM ONCORHYNCHUS GORBUSCHA IN BRITISH COLUMBIA WITH NOTES ON THE GENUS. Can. J. of Zool., Vol. 34, No. 6, Dec., pp. 573-577.

Genolinea oncorhynchi n. sp., parasitic in the stomach of Oncorhynchus gorbuscha (pink salmon) from British Columbia marine waters, is described and compared with other known members of Genolinea. Notes on host and geographical distribution of the genus are presented. (Auth. abstr.)

1193. Keleher, J. J. 1956. THE NORTHERN LIMITS OF DISTRIBUTION IN MANITOBA FOR CYPRINID FISHES. Can. J. of Zool., Vol. 34, No. 6, Dec., pp. 263-266.

Twenty-three species of minnows (Cyprinidae) are known to occur in the Province of Manitoba, Canada. The most northern collection of each in the province has been listed and mapped. In Manitoba 13 minnows reach the northern limit of their

recorded distribution. The limit of some species appears to be related to the 65° July isotherm. (Auth. abstr.)

1194. Carlin, Borje. 1957. A SMOLT EXPERIMENT ON SWEDEN'S RIVER LAGAN. The Atlantic Salmon J., No. 1, Feb., p. 10.

To compensate for the loss of natural spawning caused by hydroelectric development of the River Lagan, a hatchery was started. Release of salmon fry and fingerlings for several years had no measurable effect. In the last few years, salmon have been reared to smolt stage, tagged, and released in the river or in the sea. Of 17,000 tagged smolts released, 5 to 10 percent were recaptured. Returns from those released directly into the sea were as good as from those released in the river. Autumn liberations and one-year-old smolts gave poor returns. Recoveries generally increased with an increase in smolt length and there was a positive correlation between smolt size and size at recapture. It is concluded that recoveries are sufficiently numerous to encourage continuance of rearing salmon to the smolt stage to maintain the fishery formerly dependent on the River Lagan spawning grounds.

1195. Anon. 1957. SWEDEN ADOPTS ARTIFICIAL PROPAGATION. The Atlantic Salmon J., No. 1, Feb., pp. 11-12.

In order to find answers to the many problems created by hydroelectric development of Sweden's rivers, the Migratory Fish Committee was formed which collaborated with the Swedish State Power Board and private companies in several studies. These studies revealed that salmon reared to 6 inches before stocking attained a weight of 4 pounds after 18 months in the sea, 12 pounds at the end of the third year, and 20 pounds after 4 years, and that only 2 of 80 tagged fish recaptured inshore had strayed from their "parent" stream.

According to calculations, a return of at least 5 percent would be necessary to make artificial propagation a "paying proposition." Of 1,127 tagged fish released in the spring of 1951, 6.4 percent have been reported caught so far; as much as 8.5 percent of a slightly larger release in the spring of 1953 were caught by the end of summer in 1955. There seems to be no doubt of the profitableness of this scheme.

1196. Sedgwick, Drummond. 1957. A NEW APPROACH TO FISH PASS DESIGN. The Atlantic Salmon J., No. 1, Feb., pp. 33-36.

This consists of a general discussion of fish passage facilities with the suggestion that as upstream and downstream passage presents different problems, they be treated separately. If the two parts of fish passage are so treated, it would seem that the simplified measures that could be employed would provide better passage at no increase in cost.

1197. Weise, John G. 1957. THE SPRING CAVEFISH, CHOLOGASTER PAPILLIFERUS, IN ILLINOIS. Ecology, Vol. 38, No. 2, April, pp. 195-204.

C. papilliferus is found in typical cold spring waters in Pope and Union Counties in southern Illinois. This fish is found under rocks and other objects during the daytime but is usually found moving in the open waters at night. These nocturnal movements carry the animal to and from the connecting subterranean habitat.

C. papilliferus exhibits a highly developed photonegative response. However, thigmotaxis is undoubtedly the most important element of the behavior pattern of this fish. Practically all activities seem to be dependent on this touch mechanism. The structural basis of thigmotaxis appears to lie in the sensory papillae which are located on various parts of the body and especially concentrated on the head. Rheotactic responses appear to be reliant on phototaxis and thigmotaxis.

Water temperature in the natural habitat ranges from 54° to 57° F. throughout the year. Laboratory populations have been kept in waters with temperatures ranging from 43° to 77° F. without apparent adverse effects. Gammarus is found in large numbers in the habitat of Chologaster and furnishes nearly 100 percent of the food of this fish. The taking of food by this fish is dependent on thigmotaxis.

Sexual differentiation of matures, i.e., above 43 mm. in length, is accomplished by noting the color of the gonads through the body wall; females have yellow gonads and males have white gonads. (Auth. concl.)

1198. Haven, Dexter S. 1957. DISTRIBUTION, GROWTH, AND AVAILABILITY OF JUVENILE CROAKER, MICROPOGON UNDULATUS, IN VIRGINIA. Ecology, Vol. 38, No. 1, Jan., pp. 88-97.

Indirect evidence, based on maturation of the gonads in adults, and the distribution of post-larvae, suggests that Micropogon undulatus spawns in the ocean, not far from the entrance to Chesapeake Bay, from late summer through the winter and spring.

Growth is slow in winter, increases rapidly in March or April, and by fall a modal length of 175 to 180 millimeters is reached. The circulation pattern in Chesapeake Bay and its estuaries is such that the newly hatched croakers can be carried to the upper limits of salt water intrusion in a few days. Here they congregate, gradually shifting downstream again as they grow. At any given time, the smallest fish are found farthest up the estuaries, and the mean length increases steadily toward the Bay. By the end of the first summer, when the next year's brood is about to hatch and be carried to the estuarine nursery grounds, the brood of the previous year has almost entirely vacated the area.

During their first year of life, the juveniles seem to favor waters of relatively low salinity, for the most part ranging from zero to 18 parts per thousand. Occasionally, fairly large numbers are found in water that has no appreciable trace of salt. Croakers remain near the bottom even at very early stages.

A rough estimate of abundance in a restricted

area suggests that many millions of young croakers spend most of their first year in the upper parts of the estuaries. Perhaps it is here that clues to their fluctuations in abundance should be sought. (Auth. summ.)

1199. Wangersky, Peter J. and W. J. Cunningham. 1957. TIME LAG IN PREY-PREDATOR POPULATION MODELS. Ecology, Vol. 38, No. 1, Jan., pp. 136-139.

Analysis of the equations resulting from the introduction of a time lag in the response of the predator to changes in the prey population shows an array of possible solutions. The form of the solution is dependent upon the size of the time lag and the ratio of the equilibrium value for the prey population in the absence of predation to the equilibrium value with predation. While the equations analyzed in this paper were assumed to have linear terms, it is possible to introduce non-linear interactions. Once reasonable values are known for the many parameters, population equations of this degree of complexity are most easily handled by approximation on the analog computer. (Auth. summ.)

1200. Springer, Stewart. 1957. SOME OBSERVATIONS ON THE BEHAVIOR OF SCHOOLS OF FISHES IN THE GULF OF MEXICO AND ADJACENT WATERS. Ecology, Vol. 38, No. 1, Jan., pp. 166-171.

Conditions at the time of capture and the actions of a school of Jenkinsia make untenable the view that individual fish of this school maintained contact with one another solely by visual means. An excessive amount of slime and froth was observed to have been present suggesting some physiological preparation for schooling in a dense mass. The observation that some of the fish were in spawning condition suggests a pattern of off-shore spawning in compact schools, perhaps similar to such a habit in Mugil and Lagodon. In this instance the formidable appearance of the school was believed to have some protective value to the Jenkinsia against the medium size predators.

Fish mills, which are well known to have a tranquilizing and beneficial effect on some fishes after being subjected to the shock of capture and transfer to tanks, were established repeatedly in tanks on the Oregon with large numbers of Jenkinsia lamprotaenia from the Florida Keys and Anchoa hepsetus hepsetus from the northeastern coast of the Gulf of Mexico. The Jenkinsia mills always moved counter-clockwise while the Anchoa mills moved counter-current.

Masses of young thread-herring were found at night during windy overcast weather to be in a dense aggregation blanketing the bottom in a depth of 25 to 30 feet of water. These fish produced an unusually large amount of slime and froth when captured, which, as in Jenkinsia, suggests the possibility that the secretion of slime plays some role in the more closely packed aggregations of fishes.

A feeding aggregation of mixed Decapterus punctatus and Sardinella anchovia is described in which the fish, seen on underwater television under strong sunlight conditions, were estimated to be spaced about 2 feet from one another. A large aggregation of striped mullet was observed outside the reef off Carysfort Light in the Florida Keys. Circumstantial evidence suggests that the fish were under attack by sharks.

An assemblage of sea-life including stomatopod larvae, unidentified schools of small fish, blackfin tuna, and whale sharks was observed off the coast of Mississippi at the 500-fathom curve. The feeding actions of the whale sharks agreed in essentials with descriptions given by Gudger. Floating tail down, the shark would raise its head about 30 inches above the surface and then slowly sink downward, stopping as its open terminalmouth reached the surface. Water cascaded into its mouth setting off a flurry of tuna feeding. Raising its head above the surface, water poured out the gill slits and another cycle was started. Sampling in this case was inadequate, leaving us with the observation that whale sharks, incidentally to filter feeding, swallow quantities of tuna. We made no confirmation of this by examination of the whale shark stomachs, however.

Four spherical, yellow colored schools of pinfish, believed to have been spawning schools, were observed at the surface off the Mississippi coast in 21 fathoms under attack by porpoises and man-of-war birds. One school which was sampled was estimated to contain from 1000 to 2000 fish. (Auth. summ.)

1201. Chapman, Donald W. 1957. AN IMPROVED PORTABLE TATTOOING DEVICE. The Prog. Fish-Cult., Vol. 19, No. 4, Oct., pp. 182-184.

This device consists of a jig-saw vibrator, a frame and operating table, and a needle assembly with pigment tube socket. To minimize electrical shock, a drop cord and foot pedal are used to actuate the vibrator switch. Titanium oxide proved the most satisfactory compound used either as a marking pigment or a vehicle for other colors. The maximum retention period of tattoo marks has been found to be 5 months.

1202. Wohlschlag, Donald E. 1957. DIFFERENCES IN METABOLIC RATES OF MIGRATORY AND RESIDENT FRESHWATER FORMS ON AN ARCTIC WHITEFISH. Ecology, Vol. 38, No. 3, July, pp. 502-510. (Reprint)

An exploratory field study of Alaska Arctic Coregonus sardinella revealed that migratory forms in marine waters had higher oxygen consumption (respiratory) rates and higher metabolism rates over the body weight, temperature, and activity ranges studied than did the same species isolated in a freshwater lake. These results make possible an explanation of the reason why the lake forms are fatter and deeper-bodied than the migratory forms. The ecological and physiological implications of the study are also discussed from the standpoint of environmental adaptations.

A specially designed apparatus for measurement

of oxygen consumption rates of actively swimming fish is described with reference to field experimentation.

The problem of handling several variables simultaneously was also explored; and it was concluded that multivariate analysis of field data was both feasible and desirable. (Auth. summ.)

1203. Outten, L. M. 1957. A STUDY OF THE LIFE HISTORY OF THE CYPRINID FISH NOTROPIS COCCOGENIS. J. of the Elisha Mitchell Sci. Soc., Vol. 73, No.1, May, pp. 68-84.

This species is found in the mountain streams of the upper Tennessee River system. From September 1949 to June 1955, 91 collections of specimens were made. Standard length, age, sex, and maturity were determined for 1,065 individuals, and food and fecundity studies were made of 68 and 30 specimens, respectively. Feeding habits, spawning behavior, habitat relationships, rate of growth, time of annulus formation, maximum size, and longevity are covered.

1204. Walker, C. R. and R. M. Burress. 1957. TWO MODIFICATIONS OF THE SECCHI DISK. The Prog. Fish-Cult., Vol. 19, No. 4, Oct., p. 167.

Attachment of a yardstick or a 6-foot folding rule to a Secchi disk has proved to be especially helpful in farm pond investigations.

1205. Newell, Arthur E. 1957. EFFECTS OF JAW TAGS AND FIN-CLIPPING ON RETURNS OF STOCKED TROUT. The Prog. Fish-Cult., Vol. 19, No. 4, Oct., p. 184.

Equal numbers of tagged and fin-clipped rainbow trout and brook trout were stocked in each of several sites in a typical mountain stream in 1955. Seven similar plants of rainbow trout were made in 1956. Whereas the percent recovery was 6 percent larger for fin-clipped than for tagged brook trout and was 14 percent larger for fin-clipped than jaw tagged rainbow trout in 1955, returns from the 1956 plantings of rainbow trout were approximately equal.

1206. McCarraher, D. Bruce. 1957. THE NATURAL PROPAGATION OF NORTHERN PIKE IN SMALL DRAINABLE PONDS. The Prog. Fish-Cult., Vol. 19, No. 4, Oct., pp. 185-187.

The use of ripe northern pike spawners in hatchery ponds offers great promise as an economical and efficient method of production. Though the resultant production of fingerling pike is not high in comparison with that of standard egg-hatching procedures used by hatcheries, it does indicate that controlled natural production will furnish, for stocking purposes, a number of fingerling fish.

Implications are that the fingerlings should be cropped when the pike have reached 2 inches in length. To attempt to rear the fingerlings to a larger size is feasible, but in doing so the total number of pike per pond is greatly reduced. The question often arises, whether it is more economical (an administrative expression) to stock a few hundred 6- or 7-inch or several thousand 2- to 3-inch pike in a lake.

Present results do not suggest using more than 5 females per 1-acre pond. There is apparently no direct correlation between the use of additional females and the total crop of fingerlings produced. There undoubtedly is a relationship between the fecundity of the brood stock and the total number of fingerlings produced; therefore, it is especially desirable to use only ripe fish in this method of propagation. (Auth. summ.)

1207. Farrin, Alva E., Leslie W. Scattergood and Carl J. Sindermann. 1957. MAINTENANCE OF IMMATURE SEA HERRING IN CAPTIVITY. The Prog. Fish-Cult., Vol. 19, No. 4, Oct., pp. 188-189.

Methods are described which have successfully maintained sea herring, Clupea harengus, in tanks for periods up to 2 years. Both rectangular tanks, with capacities of 470 to 490 gallons, and circular tanks, with capacities of 100 to 110 gallons, are used. Normally 200 to 500 fish, depending on size, are maintained in the rectangular tanks and about 25 in the circular tanks. About 10 gallons of salt water per minute for the rectangular tanks and 5 gallons per minute for the circular tanks are provided by a direct-flow system utilizing a centrifugal pump. After experimenting with several foods, a diet of ground sea mussels has been selected.

1208. Anon. 1957. THE CORTLAND, NEW YORK, FISHERY STATION: A SUMMARY OF TWENTY-FIVE YEARS' WORK. The Prog. Fish-Cult., Vol. 19, No. 4, Oct., pp. 172-178.

An historical review is presented of this establishment from the time the Bureau of Fisheries, the New York State College of Agriculture of Cornell University, and the New York State Conservation Department entered into an agreement in 1932 to cooperate in its operation as a combined research and fish cultural station.

1209. Leik, Thomas H. 1957. MAXIMUM - MINIMUM WATER GAUGE. The Prog. Fish-Cult., Vol. 19, No. 4, Oct., p. 192.

This device consists of a length of stovepipe, with an inner liner of acetate matte, wired in a verticle position to a stake or other convenient site. A beer-can float with a waterproof pencil attached to the top is placed within the stovepipe. Water level fluctuations cause pencil marks to be scribed to the inner liner, thereby providing a record of maximum and minimum water levels.

1210. Potash, Milton. 1956. A BIOLOGICAL TEST FOR DETERMINING THE POTENTIAL PRODUCTIVITY OF WATER. Ecology, Vol. 37, No. 4, Oct., pp. 631-639.

A method is presented for determining quantitatively the nutrients available for plant growth in natural waters, using a pure culture of the green alga Kirchneriella subsolitaria G. S. West as an indicator organism.

The method was applied to a study of two farm

ponds. From November 3, 1950, to August 10, 1951, water samples were brought to the laboratory and filtered to remove all plankton. Six 500-ml samples from each pond were inoculated with K. subsolitaria. One sample from each pond was designated as a control. Others had added either Na_2CO_3, Ca $(NO_3)_2$, KH_2PO_4, $MgSO_4$, or all four nutrients. Temperature and light were controlled. Daily cell counts were made, using Sedgwick-Rafter counting chambers. The statistical application of the logistic function and minimum Chi-square were employed as an accurate and objective method for determining population density.

Both ponds varied seasonally in ability to support algal growth. As indicated by the control cultures, nutrient content reached a peak in November and December, declined sharply in January, increased during February and early March, and again declined during late March and April. The addition of Na_2CO_3 and $MgSO_4$ to samples did not increase the ability of the water to support growth. In both ponds, phosphate appeared as the major limiting factor during the winter. In March, nitrate replaced phosphate as the limiting nutrient, continuing so through the summer.

Samples from Upper Pond were potentially more productive than corresponding samples from Lower Pond. Lower Pond was actually more productive. There appears, therefore, to be an inverse correlation between potential and actual productivity. It is suggested that the proposed method may present a useful approach to the pond fertilization problem. (Auth. summ.)

1211. Gaufin, Arden R., Eugene K. Harris and Harold J. Walter. 1956. A STATISTICAL EVALUATION OF STREAM BOTTOM SAMPLING DATA OBTAINED FROM THREE STANDARD SAMPLERS. Ecology, Vol. 37, No. 4, Oct., pp. 643-648.

A statistical method has been presented for determining the efficiency of ecological sampling, that is, the extent to which each successive sample has revealed the species observed at the end of a series of samples. This method has been applied to macro-invertebrate fauna observed in sets of 10 bottom samples randomly drawn from marginal, pool, and riffle areas at two sampling stations on Lytle Creek, Ohio. Each area was sampled with equipment presently believed to be the most suitable for that area.

Species widespread in any given sampling area tended to vary greatly in their distribution over the area, clustering in favorable microhabitats. Many species, however, occurred in only occasional samples and were usually represented by a very few individuals. As many as 10-15 percent of species were not discovered, on the average, until at least eight samples had been taken. These results indicate the need for careful selection of the bottom types to be sampled in order that a small number of samples may give a comprehensive faunal picture. Further information on the adequacy of various sampling techniques in different classes of streams would be of great value in designing biological stream surveys. (Auth. summ.)

1212. Ricker, William E. 1956. USES OF MARKING ANIMALS IN ECOLOGICAL STUDIES: THE MARKING OF FISH. Ecology, Vol. 37, No. 4, Oct., pp. 665-670.

Since the 1870's, fish have been marked by affixing tags and by removing fins. Recaptures are used to indicate movements and migrations, discreteness of populations, rate of growth, overall mortality and survival rate, rate of exploitation by a fishery, natural mortality rate (by difference), and actual population size. Quantitative information from marking is rendered uncertain by possible systematic biases of varied types. However, reliable results have sometimes been achieved by careful selection of the most suitable tag or mark, combined with a recovery program of tested efficiency. (Auth. summ.)

1213. Pendleton, Robert C. 1956. USES OF MARKING ANIMALS IN ECOLOGICAL STUDIES: LABELING ANIMALS WITH RADIOISOTOPES. Ecology, Vol. 37, No. 4, Oct., pp. 686-689.

Advantages of using radioactive isotopes are that they are not detectable by the senses of the animal tagged or its predators, that they may be applied to large groups of animals with relative ease, that "tag" losses are eliminated, and that use of their decay rate may permit "time at large" determinations. Counteracting these advantages are the health hazard to personnel, the large initial cost of laboratory facilities to handle radioisotopes, the strong moral responsibility not to create situations of danger to the public or to natural populations, and the additional time necessary to set up an experiment with radioactivity. Although radioisotopes are useful for some investigations that have hitherto been largely impossible, they are not in all cases better than many of the conventional methods already well established. Because of increased hazards, radiotracers should be used with caution and only in those studies where they are superior to the conventional methods. However, they offer great promise for many studies where no satisfactory methods have as yet been discovered.

1214. Reed, Edward B. and John R. Olive. 1956. ANNUAL CYCLE OF NET PLANKTON IN A FLUCTUATING NORTH-CENTRAL COLORADO RESERVOIR. Ecology, Vol. 37, No. 4, Oct., pp. 713-719.

A limnological investigation of the annual standing crop of net plankton in a fluctuating reservoir was conducted from October 1953 to September 1954 on Horsetooth Reservoir in north-central Colorado. Chemical, physical, and biological samples were taken at 2-week intervals. Plankton was obtained by means of a 10-liter Juday trap. The water level fluctuated markedly from a maximum depth of 150 feet (46 meters) in April to a minimum depth of 45 feet (14 meters). Horsetooth Reservoir produced an average dry weight of plankton of 32.2 pounds per acre and may be considered mestotrophic in nature. Total net plankton production for the year was estimated to be of the order of 6,000 tons. (Auth. summ.)

1215. Borecky, Gloria Wess. 1956. POPULATION DENSITY OF THE LIMNETIC CLADOCERA OF PYMATUNING RESERVOIR. Ecology, Vol. 37, No. 4, Oct., pp. 719-727.

Pymatuning Reservoir was constructed in 1934 on the Pennsylvania-Ohio border about 40 miles south of Lake Erie. Samples taken during the period June 1952, to September 1953, from the three lakes that constitute the reservoir were analysed for numbers of Cladocera per liter, pH, and parts per million of dissolved oxygen, free carbon dioxide, bicarbonate and carbonate ion. In numbers of Cladocera, particulate organic matter, and percentage of organic matter in the bottom soils, the three lakes—Sanctuary, Middle, and Lower—rate highest, intermediate, and lowest, respectively. Densities of Cladocera are correlated with the concentrations of oxygen, bicarbonate, and carbonate ions. Analysis of variance revealed significant differences between lakes in densities of Cladocera, amounts of bicarbonate and carbonate ions.

Sums of squares and products associated with lakes for densities of Cladocera, carbonates, and bicarbonates, having been freed of the effects of variability between years and between levels of hydrogen ion concentration, were used in a multiple regression and covariance analysis. As a result of this analysis the between-lakes errors of estimate were no longer significantly different from the errors of estimate for experimental error; the lakes were statistically reduced to a common level for concentrations of hydrogen ion, bicarbonate ion, and carbonate ion. These three chemical factors are regarded as indexes of photosynthetic activity which is, in turn, considered to be a measure of the amount of food available for Cladocera. The three lakes were, therefore, statistically reduced to a common level of photosynthetic activity or equal amounts of food; under these conditions the numbers of Cladocera did not differ significantly between lakes.

On the basis of these findings it was concluded that, in the environment provided by Pymatuning, densities of Cladocera are primarily determined by food supply and show a significant correlation with chemical and physical factors that are related to food supply. (Auth. summ.)

1216. McQuate, Arthur G. 1956. PHOTOSYNTHESIS AND RESPIRATION OF THE PHYTOPLANKTON IN SANDUSKY BAY. Ecology, Vol. 37, No. 4, Oct., pp. 834-839.

A study of photosynthesis and respiration of natural communities in Sandusky Bay, on the southwest shore of Lake Erie, was made from February 2 to June 18, 1954. Average photosynthetic rates, when phytoplankton counts were high, amounted to 8 micromoles CO_2 removed/hr/10^{10} micron^3 and 2.4 micromoles/hr/mg. ash-free dry weight of suspensoids. The photosynthetic quotient (CO_2/O_2) observed had a value of 0.87. Apparent photosynthesis under completely natural conditions amounted to about 75 percent of total photosynthesis as measured in clear and blackened bottles. Relatively high photosynthetic rates at low levels of phytoplankton populations indicate the presence of important quantities of organisms that are not detected by observation under 100x magnification. A respiratory quotient (CO_2/O_2) of 3.3 was observed, suggesting CO_2 evolution considerably in excess of O_2 consumption. It is suggested that microbial components may be responsible for the high photosynthesis associated with low phytoplankton volumes and for the high value of the respiratory quotient. (Auth. summ.)

1217. Rowley, John R. and A. Orville Dahl. 1956. MODIFICATIONS IN DESIGN AND USE OF THE LIVINGSTONE PISTON SAMPLER. Ecology, Vol. 37, No. 4, Oct., pp. 849-851.

The substitution of variably controlled rubber stoppers for the machined metal and leather pistons proposed in the original Livingstone sampler is described. This is a simplification in terms of use and construction. An increase in the length of the metal sample tube adapter is proposed as a matter of convenience in detaching the tube and pistons at the end of the sampling operation without disturbing the collection.

The use of clear plastic sample tubes is suggested as a desirable modification having the advantages of providing an immediate check on the success of the sampling operation, visual accurate recording of the physical character of the sample immediately after collection before the sediment is disturbed and, also, following rapid freezing, the core may be divided into a closely graded series of samples by sectioning the plastic tube with its enclosed sample. This procedure minimizes the danger of contamination and compaction. If the freezing procedure is not employed, the transparent tube permits measurement of compaction arising during core removal. (Auth. summ.)

1218. Beak, Thomas W. 1956. A NEW IDEA IN FISH PASSES: THE BORLAND FISH-LIFT. The Atlantic Salmon J., No. 4, Dec., pp. 7-10.

In essence, the Borland Fish-lift consists of two pools, one at impoundment level and the other at tail race level with a connecting shaft. The Torr Achility lift on the River Conon in northeastern Scotland is an integral part of this 50-foot hydroelectric dam. Its lower chamber is 12 feet wide by 34 feet long by 17 feet 6 inches high, the upper chamber is 12 feet by 19 feet long, and the connecting shaft is 12 feet wide by 6 feet high. During normal operations the lift is operated on a 4-hour cycle, consisting of a 3-hour period with gates to the lower pool open to permit fish to enter, a 20-minute filling period during which the lower gates are closed and the lower chamber and connecting shaft become filled, a 30-minute period with the lower chamber and shaft flooded to permit fish to reach the upper pool and a 10-minute period for emptying the system. During an 8-month period in 1955, 3,400 salmon ranging in size from 5 to 40 pounds passed through the lift.

Twenty of these lifts are under construction or have been completed. They range in height from 15

to 150 feet and are designed to operate with maximum water level fluctuations of 80 feet in the impoundment and 17 feet in the tailrace. Considerable economy is effected in initial cost by construction as an integral internal unit of a dam. In addition, water requirements for operation are considerably below those for the pool to pool type pass (the Torr Achility lift utilizes only 15 cfs for 18 hours and 7 cfs for the remaining 6 hours of a day) effecting additional economy. This economy of operation and initial cost, and its completely automatic operation should lead to widespread adoption.

1219. Anon. 1956. EFFECTS OF DDT SPRAYING ON YOUNG SALMON AND THEIR FOOD. The Atlantic Salmon J., No. 4, Dec., pp. 33-34.

Part of the Northwest Miramichi watershed sprayed in 1954 was sprayed again in June 1956. Studies were conducted to assess the early effects of the 1956 spraying and to continue observation of the effects of the 1954 spraying.

Annual seining at 10 sampling stations in the autumn of 1956 showed that large parr (resulting from the pre-spraying spawning of adults in 1953) were very scarce as expected from the seinings in 1954 and 1955. Small parr resulting mostly from the very abundant 1955 fry (produced by spawning in 1954) were still quite plentiful and averaged 37 per 100 square yards. They were unusually thin, however, and some were found dead along the river banks throughout the seining operations and later. Fry-of-the-year were very scarce in the areas sprayed again in 1956 but present in about normal numbers in the upper areas not sprayed since 1954. At all stations these underyearlings averaged 10 per 100 square yards, or only one-half the normal pre-spray level; among the stations in the area sprayed in 1956 the average number of underyearlings was only 2 per 100 square yards.

Sampling of stream insects produced on sprayed and unsprayed areas was carried out as in 1955. Studies have been made also of the stomach contents of young salmon of all sizes collected as samples in various parts of the Northwest Miramichi River. It is clear that the 1954 spraying had serious effects on the stream insects, and these effects were still apparent in 1956. Many of the larger kinds of stream insects, for example the caddisflies, were eliminated in 1954 and have not yet returned. Some species of flies, for example midges, have increased greatly in the years following spraying, but the total volume of all insects is lower in the sprayed areas than in the unsprayed areas. The midges may be taken efficiently by small salmon fry, but are not efficiently utilized by small and large parr. This likely accounts for the very poor condition observed in the small parr seined this autumn. The 1956 spraying affected the stream insects similarly to the spraying in 1954.

It is important to emphasize once again that young salmon are killed directly by the DDT reaching the water, which accounts for the heavy mortalities of fish shortly after spraying. The reduction of stream insects which constitute the food of young salmon can be expected to have later effects on the fish. This likely lessens their chance for survival a few months after the spraying.

1220. Chavin, Walter. 1956. PITUITARY-ADRENAL CONTROL OF MELANIZATION IN XANTHIC GOLDFISH, CARASSIUS AURATUS L. J. of Exp. Zool., Vol. 133, No. 1, Oct., pp. 1-45.

Immersion of yellow goldfish in 0.7 percent sodium chloride causes the appearance of melanocytes, melanophores, and morphological criteria of the alarm reaction. Similar treatment of hypophysectomized goldfish does not elicit these responses. Implantation of goldfish or carp pituitaries induces melanogenesis in both normal and hypophysectomized fish. Control implants of brain tissue are negative in this respect. Intermedin at any dosage level used, does not cause the formation of melanin granules or melanophores in xanthic fish, but produces dispersion of melanin granules in the melanophores of grey fish.

As both the level of gonadal development and thyroid epithelial height are variable in melanized goldfish, the pituitary hormones stimulating these glands and the secretions of these glands appear unlikely as factors in the induction of the observed melanogenesis.

ACTH stimulates melanin synthesis in both normal and hypophysectomized goldfish. However, neither implantation of head kidney containing adrenal tissue nor injection of adrenal cortical extract, causes melanin formation in normal or hypophysectomized fish, thus indicating that the secretion of the adrenal cortical tissue is not responsible for the appearance of melanophores. Therefore, the extra-adrenal action of the pituitary factor, ACTH, is evidently responsible for melanogenesis in the goldfish.

The cortical (interrenal) cells of the goldfish adrenal tissue atrophy after hypophysectomy and react in a manner comparable with the mammalian adrenal cortical cells to ACTH and various other stimuli, thus confirming previous suggestions concerning their homology. Cortical cell hypertrophy and induction of melanophores in the yellow goldfish occur after ACTH administration but not after intermedin. These two pituitary factors are not the same hormone. Degeneration of the lipophores of the xanthic goldfish after hypophysectomy indicates that the pituitary is necessary for lipophore maintenance.

A simple technique for hypophysectomy of the goldfish is described. The operation time is 4-5 minutes with a mortality of less than 10 percent. (Auth. summ.)

1221. Chavin, Walter. 1956. THYROID DISTRIBUTION AND FUNCTION IN THE GOLDFISH, CARASSIUS AURATUS L. J. of Exp. Zool., Vol. 133, No. 2, Nov., pp. 259-279.

Baker et al. (1955) found thyroid follicles and tumors in various organs of the platyfish, Xiphophorus maculatus, and Chavin (1956a) (Abstract No. 1220 above) described normal thyroid follicles in the lymphoidal pronephric remnants, the head kidneys, of the goldfish, Carassius auratus.

Radioiodine uptake and radioautographic studies using 146 goldfish (Carrassius auratus L.) demonstrated that the functional thyroid occurred in the throat and in the lymphoidal pronephric remnants, the head kidneys. Both sites must be considered for an accurate evaluation of thyroidal activity in this species.

The throat thyroid has a more rapid rate of iodine uptake than the head kidney. The relative activity of the thyroid in the throat and head kidney, as indicated by the total I^{131} uptake, was variable. Considering only the normal goldfish, the head kidney was more active in 47 percent of the fish, the throat thyroid in 23 percent, and in 20 percent the two thyroid areas were approximately equal in activity. In 10 percent of the fish, radioiodine was not accumulated in the head kidney. Histological examination of this area in these fish demonstrated the absence of thyroid follicles. Follicular counts in the throat and head kidneys revealed no correlation between the number of follicles and radioiodine uptake.

The total thyroid iodine uptake in intact goldfish was 8 to 10 percent of the administered dose, with a peak of 16 percent. After hypophysectomy this was reduced to less than 1 percent. Administration of thyrotropin caused a 234 percent increase in radioiodine uptake of intact fish, and more than a 3,000 percent increase in hypophysectomized fish; the peak uptake was 40.8 percent. Thyroxin, cortisone, thiouracil, and the stress of saline immersion decreased thyroid activity in normal goldfish, but hypophysectomized fish were unaffected. Slight stimulation occurred in normal fish after saline injection. In addition, thyroxin inhibited the metabolic but not the structural response of the thyroid to thyrotropin in both normal and hypophysectomized fish. Thus, the basic endocrine mechanisms regarding the control of thyroid function in goldfish are generally similar to those of mammals. (Auth. summ.)

1222. Hubbs, Clark and Kirk Strawn. 1957. SURVIVAL OF F_1 HYBRIDS BETWEEN FISHES OF THE SUBFAMILY ETHEOSTOMINAE. The J. of Exp. Zool., Vol. 134, No. 1, Feb., pp. 33-62.

Development has occurred in 113 hybridization experiments and 57 control experiments. The taxonomic level at which laboratory hybrids can be produced in fishes approximates that of natural hybrids. This level is of a higher category than that of other animal groups.

Natural hybrids are less frequent between species that have more elaborate courtships and appear to have more control over the fate of any individual egg. Laboratory hybrids between these species are at least as easy to raise as those between species with less complicated courtships and less control over the deposition of individual eggs. Apparently mate selection is a major isolating factor in darters. The degree of allopatry of parental stocks does not appear to affect hybrid viability. The survival rate of many hybrids approximates that of their most successful parental species at any given stage under laboratory conditions. When one parent is more successful at an early stage and the other more successful at a later stage, the hybrid can have the survival rate of the former during the early stage and the latter during its more advanced stage. Therefore, the overall survival of the hybrids are no more successful than the most successful parent at any one stage.

The hybrids are not only intermediate morphologically but also have intermediate behavior and developmental patterns. There is no doubt that the gene plasms have been mixed.

Interfertility has been demonstrated between two allopatric nominal species (E. lepidum and E. grahami).

Darter females fed only one type of food (white worms) produce eggs as often as those fed white worms and mosquito larvae. However, the eggs from females fed a diet of white worms are less viable than those from females fed mainly on mosquito larvae. (Auth. summ.)

1223. Price, Robert W. and Douglas R. Calsetta. 1957. PRO-NOXFISH, A NEW SYNERGISED ROTENONE FORMULATION FOR FISH CONTROL. Proc. of the Tenth Annl. Conf., Southeastern Assoc. of Game and Fish Comm., Oct., pp. 68-69.

A brief review of the development of Pro-Noxfish, a synergized rotenone formulation, is presented. Experiments on goldfish using sulfoxide alone, rotenone alone, and the sulfoxide and rotenone combined proved the synergistic action of sulfoxide. Tests were conducted also on several other less effective synergists of rotenone.

Field tests were conducted on three lakes, a treatment of Pro-Noxfish being followed in 3 days by an application of rotenone. Effectiveness of Pro-Noxfish was demonstrated when no additional kill was observed in any of the three lakes following the application of rotenone. On the basis of investigations of the toxicity of Pro-Noxfish to sheep, chickens, ducks, guinea pigs, and white rats, it is concluded that Pro-Noxfish is safe for use in water which may accidentally be consumed by farm animals or wildlife.

1224. Barkuloo, James M. 1957. COMPARISON OF TRAWL SAMPLE RESULTS OF MAY, 1953, AND MAY, 1956, ON LAKE GEORGE, ST. JOHNS RIVER, FLORIDA. Proc. of the Tenth Annl. Conf., Southeastern Assoc. of Game and Fish Comm., Oct., pp. 75-77.

Thirty trawl hauls made in 1953 are compared with a like number made at corresponding stations in 1956. Data from these hauls show that marine fishes increased in percentage composition by numbers from 16 to 62 percent from May 1953 to May 1956. Percentage composition by weight increased in the same period from 5 percent to 15 percent. This change may possibly be attributed to the drought conditions in the area during the past year and higher salinity in the lake, but this cannot be verified due to a lack of previous salinity records for the lake.

Of a total of 32 different species collected in the 1956 trawls, 10 were marine species. Several

marine fishes, including ladyfish, Elops saurus, glut herring, Alosa aestivalis, and spot, Leiostomus xanthurus were found in May 1956 and not in May 1953. Although there was a decrease in the total number of game fishes collected, there was a marked increase in the average weight of all the major game species. For instance, the average weight of black crappie increased from 2.2 to 4.9 ounces, and the average weight of bluegill increased from 0.3 ounce to 1.5 ounces in the samples. Only 3.2 pounds of catfish were collected in the 1953 hauls, while 60.3 pounds were collected in 1956. One of the most important commercial species, channel catfish, increased from 2 fish weighing 2.7 ounces to 174 fish weighing 42.8 pounds. It appeared from the results that as the catfishes and marine species increased in numbers and weights there was a noticeable decrease in the game fish.

1225. Tebo, L. B., Jr., 1957. PRELIMINARY EXPERIMENTS ON THE USE OF SPAGHETTI TAGS. Proc. of the Tenth Annl. Conf., Southeastern Assoc. of Game and Fish Comm., Oct., pp. 77-80.

This experiment consisted of tagging fifty 8- to 10-inch largemouth bass, Number 1 strap tags being applied to the left opercle of 10 fish, Number 3 strap tags applied to the mandible of 10 fish, spaghetti tags with ends knotted but not tied together applied to 10 fish, spaghetti tags with ends tied together applied to 10 fish, and 10 fish acting as controls. One year later in September 1956, 42 of the 50 fish were recovered from the 5-acre lake in which they were stocked. Of 26 which had no tags, only two bore noticeable tag scars. Seven fish were recovered from the group with mandible strap tags and a like number from the group with tied spaghetti tags. No opercle tagged fish and only two end-knotted spaghetti tagged fish were recovered. A comparison of growth of fish with tied spaghetti tags and those with jaw tags indicates no effect of the former on growth while the opposite may be true for jaw tags.

1226. Snow, J. R. 1957. ALGAE CONTROL IN WARMWATER HATCHERY PONDS. Proc. of the Tenth Annl. Conf., Southeastern Assoc., of Game and Fish Comm., Oct., pp. 80-85.

Control of Hydrodictyon reticulatum and Pithophora oedogonia in warmwater hatchery ponds using copper sulfate, sodium arsenite, and abietylamine acetate (Delrad) is discussed. Some of the disadvantages of these chemicals as algicides for hatchery use are presented. A method of controlling the above species of vegetation in hatchery ponds using abietylamine acetate is described and recommended for use where either copper sulfate or sodium arsenite has not given satisfactory results. (Auth. abst.)

1227. Dryer, William and Norman G. Benson. 1957. OBSERVATIONS ON THE INFLUENCE OF THE NEW JOHNSONVILLE STEAM PLANT ON FISH AND PLANKTON POPULATIONS. Proc. of the Tenth Annl. Conf., Southeastern Assoc., of Game and Fish Comm., Oct., pp. 85-91.

This plant is located 12 miles west of Waverly, Tennessee, on Kentucky Lake. Its cooling water, pumped at the rate of 633,000 gallons per minute, is discharged into an artificial 82-acre harbor. Water temperatures from intake to discharge were raised approximately 10° F. during winter months, and 5-6° F. in April and May.

No significant increase in plankton production could be attributed to steam plant discharges. However, population sampling and a creel census revealed marked differences in population composition in the harbor and Kentucky Lake during the winter. Warmwater in the harbor during the winter seemed to serve as a refuge for threadfin shad, which in turn attracted large numbers of sauger. Concentrations of channel catfish in April, May, and June may have been partially due to excellent spawning habitat provided by the rip-rapped dikes. Winter populations in the harbor were composed of those species which feed principally on shad, while lake populations 4 miles downstream from the harbor consisted of species with varied feeding habits.

1228. Counselman, Jim. 1957. A METHOD FOR EVALUATING FRESHWATER SPORT FISHING UTILIZATION. Proc. of the Tenth Annl. Conf., Southeastern Assoc. of Game and Fish Comm., Oct., pp. 119-123.

This is a short-cut method; it is not proposed as a substitute for more intensive evaluations which are more costly and time consuming. It consists of an estimate of the number of fishermen, based on license sales and on population census figures for unlicensed fishermen; a determination of the number of fishermen owning major equipment, based on Outboard Boating Club of America data; an estimate of the annual cost per fisherman of owning these major items; the cost per fisherman-day of travel and minor equipment items; and the number of trips per fisherman per year. These figures are combined to give an estimate of the value of a state's sport fishing resource.

1229. Wood, M. L. 1957. BIOLOGICAL ASPECTS OF STREAM POLLUTION CONTROL IN ARKANSAS. Proc. of the Tenth Annl. Conf., Southeastern Assoc. of Game and Fish Comm., Oct., pp. 136-139.

Tests of oil field brines were conducted on small bluegill. Median tolerance limits ranged from 10,500 ppm. to 8,100 ppm. total chlorides on a 24-hour test basis depending on the formation source of the brine. Tolerance was greatly reduced as the length of exposure increased.

Calcium chloride was found to be more toxic than sodium chloride and, mixed in equal quantities, the combination was less toxic than either individually. It is apparent that brines could be constructed which would not be toxic at concentrations greater than 10,000 ppm.

A series of tests were also conducted on mayfly nymphs with brines from one formation. These showed that the mayfly nymph had a 24-hour toler-

ance limit of 10,000 ppm. chlorides which dropped to 3,600 ppm. chlorides for a 72-hour tolerance limit. Thus, 7,000 ppm. though safe for fish survival is in excess of the maximum tolerance for mayfly nymphs.

Tests on two refinery effluents revealed that both were extremely toxic to fish and that aeration and prolonged retention of the wastes lowered their toxicity.

1230. Kelly, H. D. 1957. PRELIMINARY STUDIES ON TILAPIA MOSSAMBICA PETERS RELATIVE TO EXPERIMENTAL POND CULTURE. Proc. of the Tenth Annl. Conf., Southeastern Assoc. of Game and Fish Comm., Oct., pp. 139-149.

Preliminary studies were conducted on the exotic cichlid, Tilapia mossambica, to determine the possibilities of incorporating this fish into the farm ponds and lakes in the southeast. In an 18-week experiment in concrete ponds, T. mossambica proved to be a more efficient fish than the bluegill. In feeding experiments T. mossambica gave 2.97 times greater growth than did the bluegill, in fertilization 1.69 times, and in manuring experiments 1.97 times greater growth than the bluegill. Food habit studies conducted revealed that planktonic forms of plants and animals made up the bulk of the diet under natural conditions. The minimum temperatures tolerated by T. mossambica were determined in a thermostatically controlled cold room. This fish ceased feeding at approximately 60° F. and deaths began at 52 to 58° F. with 100 percent mortality occurring at 47 to 49° F. The conclusion reached was that this fish cannot survive the winter conditions in most of the southeast. (Auth. abst.)

1231. Prather, E. E. 1957. EXPERIMENTS ON THE COMMERCIAL PRODUCTION OF GOLDEN SHINERS. Proc. of the Tenth Annl. Conf., Southeastern Assoc. of Game and Fish Comm., Oct., pp. 150-155.

The production of golden shiners in ponds stocked and fertilized in a similar manner for a period of approximately one year varied considerably. The variation in numbers was greater than in weight. One of the principal problems in golden shiner culture is the overproduction of small fish, which results in a majority of the minnows being too small for sale when the ponds are drained. Even where supplemental feeding was used, golden shiners frequently reproduced so heavily that few of the young were large enough for sale at the end of the year.

The only method of management that consistently produced nearly 100 percent marketable shiners in each pond involved the transfer of young shiners from the brood pond to rearing ponds during June and July. The rate of stocking used was 40,000 per acre. In addition to fertilization, Auburn No. 1 fish feed was fed at the rate of 10 pounds per acre per day. There were no deaths due to low oxygen concentrations during summer or fall. This method produced a relatively small number of shiners per acre, but practically all were 3 to 5 inches in length. The gross income less expenses for fertilizer and feed varied from $770 to $912 per acre.

As many as 80,000 large shiners per acre, weighing 1,000 pounds, were held in ponds during winter and early spring. They were fed Auburn No. 1 fish feed at the rate of 1 percent of their body weight per day. These shiners stayed in excellent condition and actually gained one pound per thousand in a period of 2 months. Losses amounted to less than 2 percent. Best results were obtained when all brood fish were treated for parasites and diseases before they were stocked in ponds. (From auth. summ.)

1232. Swingle, H. S. 1957. COMMERCIAL PRODUCTION OF RED CATS (SPECKLED BULLHEADS) IN PONDS. Proc. of the Tenth Annl. Conf., Southeastern Assoc. of Game and Fish Comm., Oct., pp. 156-160.

This article covers feeding, parasite and disease control, production of fingerlings and marketable fish, and preparation for the market, and presents a summary of management procedures. If these procedures are followed, approximately 900 pounds of fish per acre should be produced at a cost for fertilization and feeding of about 12 cents per pound.

1233. Swingle, H. S. 1957. PRELIMINARY RESULTS ON THE COMMERCIAL PRODUCTION OF CHANNEL CATFISH IN PONDS. Proc. of the Tenth Annl. Conf., Southeastern Assoc. of Game and Fish Comm., Oct., pp. 160-162.

In preliminary testing based on the production of two 0.1-acre ponds, channel catfish exhibited promise as a commercial pond species. With feeding and fertilization, a stocking rate of 1,000 fingerlings per acre resulted in a recovery of 773 pounds per acre after 11 months, while 2,000 fingerlings per acre gave 1,242 pounds per acre. Commercial production awaits the development of reliable and inexpensive rearing of fingerlings for stocking.

1234. Swingle, H. S. 1957. REVISED PROCEDURES FOR COMMERCIAL PRODUCTION OF BIGMOUTH BUFFALO FISH IN PONDS IN THE SOUTHEAST. Proc. of the Tenth Annl. Conf., Southeastern Assoc. of Game and Fish Comm., Oct., pp. 162-165.

This paper summarizes the results on preliminary and supplementary experiments on the commercial production of this species. Selection and care of brood fish, treatment for parasites and disease, wintering of brood fish, spawning, raising fingerlings for stocking, raising fingerlings to market size, and loss on dressing are discussed. A summary of revised management procedures is presented.

1235. Nelson, Ben. 1957. PROPAGATION OF CHANNEL CATFISH IN ARKANSAS. Proc. of the Tenth Annl. Conf., Southeastern Assoc. of Game and Fish Comm., Oct., pp. 165-168.

Welded muskrat-wire pens, 5-6 feet by 10 feet, are utilized for all spawning. A ripe female and a larger ripe male are placed in each pen when water

temperatures reach 60° F. A nail keg containing a layer of coarse sand or gravel has previously been placed on its side in 18 inches of water. Spawning takes place when water temperatures reach 68-70° F. By the ninth day following spawning, eggs have hatched and fry can be moved to a rearing pond. At this time the spent female is replaced with a ripe female and the nail keg is replenished with gravel; the male in most instances will spawn again. Fry are moved to a rearing pond, particular care being taken to insure proper water conditioning. As the first 2 weeks is the most crucial period, rearing pond conditioning by complete drainage and drying to eliminate foreign fish and reduce parasites is important. Proper feeding is also highly important at this time.

During 1951-53 from 100,000 to 500,000 fingerlings were raised at a cost for feed of $.0035 to $.0040 per fish. During 1956, 24 spawns consumed 1,100 pounds of feed at a cost of $60. At an age of 2 months they were 5 inches long and weighed 36.5 pounds per thousand.

1236. Chimits, Pierre. 1957. THE TILAPIAS AND THEIR CULTURE. (A second review and bibliography.) FAO Fish. Bull., Vol. 10, No.1, Jan.-March, pp. 1-24.

The publication in 1955 of the author's "Tilapia and its culture, A Preliminary Bibliography" was the first attempt on the part of the FAO Fisheries Division to review the voluminous literature on this group of useful food fishes, and to provide a convenient summary of the information abstracted from the papers listed. Since that time many further papers have been published, and a search of the literature has unearthed others not listed in the original article. It has been thought useful to publish this supplementary article to bring together this mass of new information. Additional information is given on all three chapters of the original article, and there is a fourth chapter, concerning barrier-lakes and artificial reservoirs that have been stocked with tilapia, using a technique which is half-way between that used for open waters and that adopted for pond culture. There is also a brief fifth chapter on the use of tilapia for other purposes.

1237. Carter, Ellis R. 1957. INVESTIGATIONS AND MANAGEMENT OF THE DEWEY LAKE FISHERY. Proc. of the Tenth Annl. Conf., Southeastern Assoc. of Game and Fish Comm., Oct., pp. 254-270.

Dewey Lake, an 1,100-acre impoundment on Johns Creek in Floyd County, Kentucky, was impounded in 1950. Rotenone sampling and a general creel census have been conducted each year since 1951. In 1954 and 1955, more intensive studies were conducted, consisting of a creel census, rotenone sampling, netting, and tagging. Early in 1955, as many gizzard shad as possible were removed by selective application of rotenone.

The percentage representation, by number, of game fish in the netting sample decreased in 1955, while the representation by weight increased. This would seem to indicate a decline in numbers or movement of game species, or a greater harvest by fishermen, and an increase in average weight. There was an actual increase in average weight for each of the game species in 1955, except northern pike. Representation of pan fish in the net catch increased in 1955 by both number and weight. A decrease in average weight of food fish is primarily attributable to a decrease in the average weight of flathead catfish.

According to the reports of fishes tagged in 1955 and recaptured by fishermen, the rate of catch of all species increased and the increase in catch rate was greater for Kentucky bass than for any other species.

Although the percentage representation of game fishes increased by both number and weight, according to rotenone studies the average weight of this group decreased in 1955. This is probably due to a greater spawn of game fishes, noticeable in the data concerning success of reproduction. The tendency of nets to catch larger fish would account for failure of netting data to show an increase in percentage representation of game fish by number in 1955, while rotenone studies do show an increase. The percentage representation of pan fish increased by both number and weight in 1955 according to rotenone studies which is in agreement with netting data. Average weight of food fishes increased in 1955, according to population samples taken by use of rotenone, which is in conflict with netting data.

The standing crop, average weight, and percentage representation by both number and weight of gizzard shad, and the entire trash fish group, decreased in 1955, according to rotenone studies. The success of the selective shad kill is reflected in the fact that gizzard shad represented 64.9 percent of the decrease in standing crop of forage and trash fishes. This decrease in standing crop is considered significant even though the standing crop of other species declined also.

Results of the creel census on Dewey show that the average weights of game fish and food fish decreased in 1955, while average weight of pan fish did not change. Game fish made up a greater proportion of the total catch in 1954 than in 1955. Still fishing from a boat with live bait was the most rewarding of the fishing methods used in 1955. Fishermen caught fish at a greater rate in 1954 than in 1955.

Many of the changes in the Dewey Lake fishery shown by comparative studies in 1954 and 1955 are believed to be attributable to the selective poisoning of shad. One additional effect is the increased growth of young-of-the-year shad in 1955, necessitating their removal by strip poisoning in September of that year. This method is quite effective; it might be effective in selective poisoning of shad without an initial aerial spraying being required. (From auth. concl.)

1238. Irwin, W. H. 1957. THE MANAGEMENT OF LARGE IMPOUNDMENTS FOR FISH PRODUCTION. Proc. of the Tenth Annl. Conf., Southeastern Assoc. of Game and Fish Comm., Oct., pp. 271-275.

This is a general treatise of basic considerations and problems of management of large reservoirs. Subjects covered are the nature of reservoirs, indices of productivity, characteristics of fish populations, management approaches, and possible methods of increasing harvest.

1239. Fetterolf, Carlos M., Jr. 1957. STOCKING AS A MANAGEMENT TOOL IN TENNESSEE RESERVOIRS. Proc. of the Tenth Annl. Conf., Southeastern Assoc. of Game and Fish Comm., Oct., pp. 275-284.

This paper summarizes available information on the relative success or failure of each introduction and the resulting effect on the sport fishery. Species covered are gizzard and threadfin shad, white crappie, yellow walleye, white bass, rainbow trout, and muskellunge. It is concluded that there is no evidence to indicate that any introduction made in Tennessee reservoirs has been detrimental to populations already present.

1240. Hulsey, Andrew H. 1957. EFFECTS OF A FALL AND WINTER DRAWDOWN ON A FLOOD CONTROL LAKE. Proc. of the Tenth Annl. Conf., Southeastern Assoc. of Game and Fish Comm., Oct., pp. 285-289.

Plans for a fall and winter drawdown (1955-56) were carried out on Nimrod, a turbid, flood control lake. The surface acreage was reduced from approximately 3,600 acres to 700 acres. Commercial fishermen removed over 200,000 pounds of rough fish most of which were smallmouth buffalo. Following the drawdown and subsequent filling, the water cleared up and remained clear. An increase in the number and size of young black bass and white bass was recorded with a resultant decrease in the number of young channel catfish, carp, drum and buffalo. Larger numbers of young sunfish and minnows were noted. The fish population, as tabulated by weight, showed a marked change in that the edible forage species (buffalo, drum, etc.) were reduced approximately one-half and the non-edible forage species (shad, minnows, etc.) were increased approximately three times. Boat dock operators reported improved sport fishing, especially for small white crappie. (Auth. abst.)

1241. Guyselman, J. Bruce. 1957. SOLAR AND LUNAR RHYTHMS OF LOCOMOTOR ACTIVITY IN THE CRAYFISH CAMBARUS VIRILIS. Physiol. Zool., Vol. 30, No. 1, Jan., pp. 70-87.

The locomotor activity of three groups of C. virilis kept in constant darkness and in continuously changing water was recorded for 15-day periods. Animals exposed to normally occurring atmospheric pressure fluctuations exhibited a solar (24-hour) pattern characterized by maximal activity between the hours of 7:00 and 10:00 p.m. Animals subjected to a constant total pressure exhibited a solar pattern composed of bimodal maxima occurring between 2:00 and 4:00 a.m. and between 4:00 and 8:00 p.m.

The activity of pressurized and non-pressurized animals contained a lunar (12.4 hour) cycle which had similar phase relationships to lunar cycles of barometric pressure fluctuations. Solar rhythms of activity in non-pressurized animals showed a statistically significant correlation with similar cycles of barometric pressure changes. Crayfish maintained at a constant total pressure exhibited solar rhythms which seem to be correlated with some phenomenon associated with the intensity and frequency of atmospheric pressure fluctuations. Since the condition of constant pressure on animals did not obliterate 24- and 12.4-hour cycles, it is concluded that barometric pressure fluctuations exert no causal influence on activity.

A technique and method are described which permit the study of locomotor activity over relatively long periods of time. (Auth. summ.)

1242. Prosser, C. L., L. M. Barr, R. D. Pinc, and C. Y. Lauer. 1957. ACCLIMATION OF GOLDFISH TO LOW CONCENTRATIONS OF OXYGEN. Physiol. Zool., Vol. 30, No. 2, April, pp. 137-141.

The oxygen consumption of most fish is independent of available oxygen down to some critical partial pressure, below which it is oxygen-dependent. The extent to which an individual fish can change its oxygen relations by acclimation to different oxygen concentrations can be ascertained by its tolerance to hypoxia and by its oxygen consumption as a function of oxygen supply.

Goldfish acclimated for several days to low-oxygen concentrations (0.7 - 2.0 ml O_2/liter) show a reduction in critical concentration (break between independent and dependent metabolism) to 1.5 ml O_2/liter, as compared with fish from aerated water (5-6 ml O_2/liter), in which the critical concentration at 22°-23° C. is 3.1 ml O_2/liter. The oxygen-independent metabolism of quiet acclimated goldfish is 0.163 ml O_2/gm/hr, as compared with 0.239 ml O_2/gm/hr in fish from aerated water.

The goldfish acclimated to low oxygen have increased hemoglobin concentrations and red cell counts. It is concluded that goldfish can adapt to reduced oxygen by an increased oxygen capacity of the blood and by a lowering of the oxidative activity of some tissues. (Auth. summ.)

1243. Llewellyn, J. 1957. THE LARVAE OF SOME MONOGENETIC TREMATODE PARASITES OF PLYMOUTH FISHES. J. Mar. Biol. Assoc. of the U. K., Vol. 36, No. 2, June, pp. 243-259.

Techniques for the rearing of monogenean larvae are described. The new term 'oncomiracidium' is proposed for the larvae of monogenetic trematodes. Eleven new oncomiracidia of fish parasites are described, bringing the total now known to 35. These oncomiracidia are tentatively classified, and the classification is compared with the existing classification of adult monogeneans. (Auth. summ.)

1244. Guelin, A. 1957. LA CONTAMINATION DES POISSONS ET LE PROBLEME DES EAUX POLLUEES. J. Mar. Biol. Assoc. of the U.K., Vol. 36, No. 2, June, p. 435.

It has been previously reported by the writer

that the intestine of fishes caught offshore in the Mediterranean is free from enterobacteria, whereas in those caught in the littoral zone there is an intestinal flora similar to that in man or in warm-blooded animals.

The waters sampled far from any shore are as a rule free from bacteria and intestinal bacteriophages found in the littoral zone. The question arises how far the bacteriological aspect of the viscera of fishes is correlated with the sanitary state of waters in which they live.

Sixty-one specimens of Ctenolabrus rupestris, in which no infestation could be ascertained in preliminary examination, were contaminated with either Enteramoeba coli or with coliphage. In a week's time all these fish had freed themselves completely from the contaminating agent.

These results show that the investigation of the enterobacteria and enterophages in fishes could give information as to the possible pollution of the waters in which the animals live. (Auth. abst. translated from the French. Orig. article appeared in Annales Inst. Pasteur, 1954, T. 86, pp. 303-309.)

1245. Currie, R. I. and P. Foxton. 1957. A NEW QUANTITATIVE PLANKTON NET. J. Mar. Biol. Assoc. of the U. K., Vol. 36, No. 1, Feb., pp. 17-32.

The apparatus described in this paper was constructed for the purpose of sampling the zooplankton standing crop in the ocean in a quantitative manner. A meter is described, which will record on a smoked glass cylinder both the depth and amount of water which a net filters as it is hauled vertically through the water. The meter is mounted in a brass drum which is positioned in front of the silk filtering section of the net. In front of the meter a long canvas sleeve carries the throttling rope which closes the net by the Nansen method. Calibration of the meter for depth is done by using reversing thermometers and lowering to a series of suitable depths. Flow calibration is easily accomplished in the field by towing the canvas sleeve and meter without the silk net. The method of smoking the glass cylinders and taking photographic records of them is described. From the records it is possible to study the complete behavior of the net below water—what depth range it has fished, how much clogging occurred, the depth of closure, etc. (Auth. summ.)

1246. Noble, Elmer R. 1957. SEASONAL VARIATIONS IN HOST-PARASITE RELATIONS BETWEEN FISH AND THEIR PROTOZOA. J. Mar. Biol. Assoc. of the U. K., Vol. 36, No. 1, Feb., pp. 143-155.

From July 1955 to June 1956 a study of host-parasite relations between three species of marine fish and their protozoa was made at Plymouth, England, Callionymus lyra, a bottom-dweller, tends to be more abundant during the summer months consumes a wide variety of food, and was more heavily infected with protozoa than were the other two species of fish. Gadus merlangus is an active predator, feeding on small fish, and although it has about the same numbers of kinds of protozoa as does C. lyra, it was less heavily parasitized. G. merlangus, however, was more heavily parasitized with worms than were the other two fish. Microstomus kitt is a sluggish bottom-dweller, feeding on annelids, and, although over 99 percent were infected with myxosporidia, the intensity of infection was generally low. Very few other parasites were found in M. kitt.

An active predatory habit combined with a taste for a wide variety of food appears to predispose to heavy parasitism. Some evidence for seasonal variations in intensities of protozoan infection in Callionymus lyra was obtained, but for conclusive results more precise methods of measuring numbers of parasites, and further studies carried on over a period of at least three consecutive years, must be made. The report is presented primarily to emphasize the importance of an ecological approach to the study of parasitology. (Auth. summ.)

1247. Abbott, B. C. and Dorothy Ballantine. 1957. THE TOXIN FROM GYMNODINIUM VENEFICUM BALLANTINE. J. Mar. Biol. Assoc. of U. K., Vol. 36, No. 1, Feb., pp. 169-189.

Methods of extraction of the toxin from cultures of Gymnodinium veneficum are described. This is now done by dialysis and evaporation under reduced pressure. The toxin molecule must be large, as it cannot penetrate a dialysis membrane; it is soluble in water and the lower alcohols, but insoluble in ether and chloroform. It is unstable in acids, turning into another toxic product, and is decomposed by hot alkali, though in neutral solution is more or less thermostable. The toxin as it occurs in a sea water is not the same as paralytic shellfish poison, but there are some resemblances between this and the 'acid extract', though much more work is needed to check this point.

The action of the toxin on a variety of animals is described, and an attempt is made to devise an approximate assay technique using gobies as the test animals. The action has also been observed on a range of isolated preparations, and although the final conclusion as to the mode of action is not quite clear, we feel confident that the site of action in whole animals is in the nervous system probably acting on ganglion transmission. (From auth. summ.)

1248. Bowen, H. J. M. 1956. STRONTIUM AND BARIUM IN SEA WATER AND MARINE ORGANISMS. J. of Mar. Biol. Assoc. of the U. K., Vol. 35, No. 3, Oct., pp. 451-460.

Strontium and barium have been determined in sea water. The strontium content of sea water was found to be 8.5 mg/l., in agreement with recent work, but the barium content (6.2 micro g/l.) is lower than previously reported values.

Strontium and barium have also been determined in a number of marine algae, mollusc shells and corals. All the organisms studied concentrate these elements from sea water, but whereas brown algae discriminate markedly for them in preference to calcium, mollusc shells discriminate against them.

The amounts of strontium found in fossil corals are very much smaller than they are in recent corals, and there is an approximately linear relation between the Ca/Sr ratio and geological age as far back as the Devonian period: the Silurian results are anomalous. It is suggested that strontium is an element which accumulates in sea water, though further work is needed to establish the point. (Auth. summ.)

1249. Ballantine, Dorothy. 1956. TWO NEW MARINE SPECIES OF GYMNODINIUM ISOLATED FROM THE PLYMOUTH AREA. J. of Mar. Biol. Assoc. of the U.K., Vol. 35, No. 3, Oct., pp. 467-474.

Two new species of dinoflagellate, Gymnodinium vitiligo and G. veneficum, have been described and the toxicity of G. veneficum is discussed briefly. Notes and figures on cell division in these organisms are also included. (Auth. summ.)

1250. Currie, R. I. and P. Foxton. 1956. THE NANSEN CLOSING METHOD WITH VERTICAL PLANKTON NETS. J. of Mar. Biol. Assoc. of the U.K., Vol. 35, No. 3, Oct., pp. 483-492.

The object of the work described in this paper was to find out if the Nansen closing method used with vertical net hauls can be reliable in quantitative plankton investigations.

Barnes has shown that the International net, which is a fine-meshed net, can lose (through the mouth) a significant part of the catch at the moment of closure by the Nansen method. The net used by Barnes, however, is not comparable to the 'Discovery' net which has a much higher filtration coefficient and is used with gear which ensures that there is no relaxation of tension on the towing wire when the net is closed. Underwater observations and films have demonstrated that closure is very rapid and that there is little doubt that the Nansen closing method can be quite reliable provided certain precautions are observed. (Auth. summ.)

1251. Llewellyn, J. 1956. THE ADHESIVE MECHANISMS OF MONOGENETIC TREMATODES: THE ATTACHMENT OF PLECTANOCOTYLE GURNARDI (V. BEN. AND HESSE) TO THE GILLS OF TRIGLA. J. of Mar. Biol. Assoc. of the U.K., Vol. 35, No. 3, Oct., pp. 507-514.

The mechanism by which the monogenetic trematode Plectanocotyle gurnardi attaches itself to the gills of various species of Trigla has been shown to consist of hooks borne on a posterior appendage, together with three pairs of clamps which, although differing somewhat in structure, act by an extrinsic muscle-tendon-fair-lead-hinged jaw mechanism in exactly the same manner as Kuhnia scombri on Scomber scombrus. On the basis of clamp structure, Plectanocotyle appears to be more nearly related to the Mazocraeidae than to the Discocotylidae in which it is included at present. (Auth. summ.)

1252. Wilimovsky, Norman J. and Warren G. Freihofer. 1957. A GUIDE TO LITERATURE ON SYSTEMATIC BIOLOGY OF PACIFIC SALMON. U. S. Fish and Wildlife Service Spec. Sci. Rep. — Fish., No. 209, April, 266 pp.

This report is intended to serve as a guide to those papers (within the range of the literature examined) treating the systematic biology of the Pacific salmon (Oncorhynchus spp.). The word systematics is used as defined by G. S. Myers "...the study of the nature and origin of the natural populations of living organisms, both present and past."

1253. deSylva, Donald. 1956. THE FOOD OF TUNAS. Bull of the Int. Oceanographic Foundation, Vol. 2, No. 1, March, pp. 37-48.

Information gathered from all over the world— Japan, France, Italy, Australia, United States, etc. —indicates that tuna will eat almost anything, and probably eat whatever is most abundant and easiest to obtain. The presence of adult tuna in any particular area is probably related to the total amount of food present rather than to the kind of food. That they feed anywhere is shown by the presence in stomach contents of animals characteristic of the open ocean or the coral reef, the surface waters or the deep sea, and the bottom. At the surface, they apparently feed on crabs, shrimp larvae and fish larvae, while beneath the surface they feed on squids and fishes. In general, the juveniles feed mainly on crab and shrimp larvae, while the adults feed upon fishes and squid.

A certain universal pattern to their feeding is apparent in the presence of certain major groups of animals: sauries, amphipods, squids and krill for albacore; plectognaths, squids, squillas, deepsea fishes, crabs and shrimps for yellowfin and blackfin tunas; squids, sardines, flying fishes, herring, and krill for bluefin tuna. For all tunas, the important groups, as a whole, seem to be squids, krill, amphipods, shrimps, crabs, squillas, deepsea fishes, sauries and plectognaths.

1254. Andrew, F. J., P. C. Johnson and L. R. Kersey. 1956. FURTHER EXPERIMENTS WITH AN ELECTRIC SCREEN FOR DOWNSTREAM-MIGRANT SALMON AT BAKER DAM. Prog. Rep., Int. Pacific Salmon Fish. Comm., 29 pp.

A previous experiment conducted at Baker River Hydroelectric Plant in 1955 to measure the effectiveness of a prototype electric screen for guiding downstream-migrant sockeye salmon (Oncorhynchus nerka) and coho salmon (O. kisutch) showed that a "galvanotropic screen" that had been very successful in small-scale experiments at Cultus Lake in 1953 and 1954 was not effective in the forebay of this dam. The marked difference between the results demonstrated some limitations of laboratory and small-scale experiments as a means of predicting the practical guiding efficiency of an electric screen in a large, deep forebay. An electric screen 200 feet long and 50 feet deep energized with direct current was placed across the forebay of Baker dam in 1956 and a by-pass trap, much larger than the one used in 1955, was pro-

vided at the crest of the dam. The type of electric screen used in these experiments was again found to be ineffective. During both daylight and darkness most of the fish used the spillway as an exit from the forebay regardless of whether the electrodes were energized or not. A webbing barrier only 15 feet deep placed across the forebay in the same location as the electric screen was much more effective. The by-pass used in these experiments was quite effective in collecting fish during darkness but was ineffective during daylight.

1255. Bhimachar, B. S., S. K. Banerji and G. Venkataraman. 1957. A STUDY OF THE VARIABILITY IN THE FISH CATCHES TAKEN BY SUCCESSIVE HAULS IN THE INSHORE WATERS OFF CALICUT. Indian J. of Fish., Vol. 4, No. 1, April, pp. 1-19.

This study relates to the analysis of variance in four series of replicate fish hauls in respect of number of specimens of each species of fish, total weights of hauls and the sizes of the common species of fishes in the catches. In taking the fish catches, controlled working conditions were maintained as far as possible. The variation between hauls was non-significant while that between zones was significant indicating that while the population was, more or less, constant in any particular area of the sea, it was different from zone to zone. The variation between dates was also non-significant, reflecting that the fishery was steady during the period of sampling. The mean size of the common species of fishes was also almost constant in all the hauls.

The coefficient of variation for a single haul is found to vary between 58 to 112 percent. The real source of this variability is due to the inherent characteristics of the fish population which consists of various pelagic and demersal species. This is supported by the fact that the standard deviation and the mean catch of any species in the replicate hauls of any series are found to be roughly proportional, suggesting that the different species are segregated into groups in the sea.

It is shown that, for a preliminary study of the fish population, 3-4 sample hauls per week may be adequate under certain circumstances. (Auth. summ.)

1256. Wood, Kenneth G. 1956. ECOLOGY OF CHAOBORUS (DIPTERA: CULICIDAE) IN AN ONTARIO LAKE. Reprint from Ecology, Vol. 37, No. 4, Oct., pp. 640-643.

The nocturnal movement of Chaoborus larvae and pupae was demonstrated in an Ontario lake. They rise up from the bottom ooze into the free-water layers at sunset and return at sunrise. An average of 22 percent of the benthic larvae participated. Recently hatched larvae spend the first few days of their existence continually in the free-water habitat, and subsequently dwell in the bottom ooze during the day.

The life cycle of Chaoborus in Little McCauley Lake, Algonquin Park, Ontario, is of one year's duration. During the fall and early winter the abundance of bottom-living larvae decreases in the shallow areas (3-8 meters) and greatly increases in the deep (8-10 meters)—an ablittoral migration. During the spring the abundance of larvae decreases in the deep and increases in the shallow areas—an adlittoral migration. The tremendous annual variation in the concentration of larvae in the profundal zone was correlated with the semi-annual migrations of the larvae and pupae. During 1948 the total population of Chaoborus within the 3-meter contour of Little McCauley Lake varied from 108 million in June to 488 million in September—values interpreted as the minimum and maximum populations of that year. (Auth. summ.)

1257. Miyake, Iwao and Walter R. Steiger. 1957. THE RESPONSE OF TUNA AND OTHER FISH TO ELECTRICAL STIMULI. U. S. Fish and Wildlife Service, Spec. Sci. Rep.--Fish. No. 223, June, 23 pp.

A theoretical study of the potential, electric field, and current density for spherical electrodes deeply submerged in a large body of water and a theoretical study of the head-to-tail potential and current passing through a fish when immersed in fresh and salt water with a uniform electric field are included as appendices.

Preliminary experiments with aholehole in a small (12 x 2 x 2 feet) tank, using pulsed direct current with approximately square wave form indicated that the optimum frequency for electrotaxis was 10 c.p.s. and that the minimum peak current for satisfactory response (12 amperes) was associated with an on-fraction of 0.06 to 0.08. Total peak current requirements decreased with increase in length of the fish. Extrapolating these results, it was calculated that a current of 130 amperes at a potential of 60 volts would be required to induce electrotaxis in a 30-cm. fish in a tank of much larger size (35 x 11 x 4 feet). This was best achieved by capacitor discharge.

An apparatus was constructed for experiments with tuna and other large fish in the larger tank. It consisted of a bank of capacitors (55,000 mfd.) charged by two series banks of ten 6-volt automobile storage batteries and controlled by a variable speed mechanical contactor. With this apparatus it was possible to induce electrotaxis in small (50-cm.) yellowfin tuna with electrodes spaced a distance of 16 feet. The electrotactic effect increased with pulse frequency up to 20 c.p.s., the maximum tested. It was calculated that in the open sea 23 times as much power would be required to obtain an equivalent response with the electrodes spaced 16 feet apart. (Auth. summ.)

1258. Rees, William H. 1957. THE VERTICAL AND HORIZONTAL DISTRIBUTION OF SEAWARD MIGRANT SALMON IN THE FOREBAY OF BAKER DAM. Fish. Res. Papers, Wash. Dept. of Fish., Vol. 2, No. 1, June, pp. 5-17.

In the spring of 1955, experiments were conducted at Baker dam to select a suitable type of fishing gear that could be used to determine the vertical and horizontal distribution of downstream migrant sal-

monoids in the forebay of high-head dams. Variable mesh gill nets were found to be very effective in sampling the vertical and horizontal distribution of migrant salmonoids. Gill nets 60 by 15 feet deep were fished simultaneously at 12 various depths and horizontal positions along a straight line from 400 to 500 feet in front of Baker dam between March 14 and June 24, 1955. The catch of salmonoids in the nets indicated clearly that the area of greatest density was the surface layer (0-15 feet), and that the density of fish decreased with increasing depth. Below 45 feet practically no fish were caught. Using the refined catch per net figures, the relative abundance for various species between different depth levels in the forebay showed definite preference by all species for the surface levels. Although the surface layer comprised only 19 percent of the total cross-sectional area of the forebay, it contained 89 percent of the combined species.

Comparison of spillway and turbine discharge with vertical distribution indicated a preference by both silver and sockeye salmon for the deep layers (15-90 feet) when there was only the turbine exit available and a preference for the surface layer when there was both a turbine and spillway exit available. Considerable variation in relative abundance occurred within the surface layer with the greatest abundance occurring in the shore regions. About 33 percent of the combined species were found in 20 percent of the total surface layer. Although light intensity did not affect vertical distribution of the migrants, it definitely affected their horizontal distribution in the surface layer. During periods of clear weather silvers and sockeye were caught in greatest abundance along the shores, while in cloudy weather the fish showed less preference for the shore regions. No milling effect in the forebay was demonstrated, although the largest catches of downstream migrants were made along the west shore and the largest catch of fish headed upstream was made on the east shore.

The various mesh sizes demonstrated a sensitive size selectivity toward the length of fish caught. A slight preference for the shallower shore area was demonstrated by the smaller silver salmon. No relationship could be demonstrated between temperature and vertical distribution. (Auth. summ.)

1259. Regenthal, Albert F. 1957. DOWNSTREAM MIGRANT SALMON SURVIVAL IN FREE FALL FROM A SKI-JUMP SPILLWAY. Fish. Res. Papers, Wash. Dept. of Fish., Vol. 2, No. 1, June, pp. 19-24.

Baker River hydroelectric plant, an arch-type structure rising 285 feet above bedrock, is located on Baker River in northwestern Washington. The water intake structure for power generation is 85 to 107 feet below normal reservoir levels. Normal spill during periods of downstream migration is restricted to three centrally located gates and at these times water so discharged falls free for 80 feet before striking the curved face of the dam. Investigations have shown that approximately 95 percent of the downstream migrants pass over the spillway. Mortalities were determined to be 63.5 percent for sockeye salmon and 54.0 percent for silver salmon.

Studies at Glines Dam on Elwha River, where spill over the crest of the dam falls free for 180 feet into a pool, showed a survival of 92 percent for yearling silver salmon. This prompted construction and testing of a temporary ski-jump spillway on Baker Dam.

Because of premature termination of this study due to washout of downstream fish collection facilities, the statistical analysis designed for this experiment could not be used. Survivals of three experimental releases through the ski-jump spillway were estimated, however, at 68, 79, and 83 percent. These estimates were not adjusted for the 8-12 percent estimated mortality occasioned by fall-out from the underside of the jet which struck the face of the dam. The results, while not up to usual required standards of accuracy because of the unfortunate early termination of the study, are conclusive in indicating that downstream passage of salmon in free-falls of this nature is a feasible method.

1260. Smith, Richard T. and Elmer Quistorff. 1957. SURVIVAL CAPACITY OF SPERMATOZOA OF THE CHINOOK SALMON AND STEELHEAD TROUT. Fish. Res. Papers, Wash. Dept. of Fish., Vol. 2, No. 1, June, pp. 73-76.

Ova of steelhead trout were fertilized with milt that had been stored in sealed vials for 2.5 and 5.0 hours at stream-water temperature. A control lot was fertilized according to standard hatchery practice. Steelhead milt stored for 2.5 and 5.0 hours before fertilization of the ova resulted in hatching losses of 96.8 percent and 99.7 percent, respectively, for the two lots in contrast to a loss of 4.2 percent among the control eggs artificially fertilized in the usual manner.

Chinook salmon ova were fertilized with milt that had been stored for 2.5 and 5.0 hours in sealed vials, and similar lots were fertilized with milt stored in dead males. The control lot was artificially fertilized in the customary manner. Chinook ova fertilized with milt retained in the dead males had a lower mortality than those fertilized with milt stored in vials for the same periods in the same water temperature medium. Chinook spermatozoa stored under the experimental conditions could be of use in practical fish culture after 5.0 hours retention in the dead males at stream temperature or after 2.5 hours in storage in sealed vials at stream-water temperature. (Auth. summ.)

1261. Ikezaki, Francis M. and Glenn L. Hoffman. 1957. GYRODACTYLUS EUCALIAE N. SP. (TREMATODA: MONOGENEA) FROM THE BROOK STICKLEBACK, EUCALIA INCONSTANS. The J. of Parasit., Vol. 43, No. 4, Aug., pp. 451-455.

Gyrodactylus eucaliae, a new species observed on the brook stickleback, Eucalia inconstans, is described and compared with 9 other species previously reported from North America. The anchors

and marginal hooks have been found to be anisotropic. The anchors, but not the ventral bar, dorsal bar, and the apron are soluble in 16 percent KOH. Placing the fish hosts in 0.5 percent nembutal or urethane was found to be the best method of getting mucus-free parasites rapidly. A Gram-positive bacillus and yeast, species unidentified, were found to be constant intestinal organisms in Gyrodactylus eucaliae. Diluted tissue culture medium was successful for maintenance of the worms at 4° to 6° C., but not for reproduction. Macerated filtered Eucalia medium was unsuccessful for maintenance and reproduction. The continued decline in intensity of infections on fishes in aquaria suggests the possibility of an actively acquired immunity by the host, Eucalia inconstans. (Auth. summ.)

1262. Fischthal, Jacob H. 1957. CESTRAHELMINS LARUEI N. G., N. SP., A DIGENETIC TREMATODE FROM THE MUSKELLUNGE, ESOX M. MASQUINONGY MITCHILL. The J. of Parasit., Vol. 43, No. 4, Aug., pp. 484-487.

During a parasite survey of northwest Wisconsin fishes Fischthal (1950) recorded a moderate infection (12 worms) of Macroderoides spiniferus occurring in the small intestine of the one muskellunge collected on August 1, 1945 from Teal Lake, Sawyer County. A re-study of this material through serial cross and frontal sections indicated that the previous identification was erroneous and that a new genus and species, Cestrahelmins laruei, of uncertain familial relationship is represented. Generic and specific descriptions are given.

1263. Walburg, Charles H. and James E. Sykes. 1957. SHAD FISHERY OF CHESAPEAKE BAY WITH SPECIAL EMPHASIS ON THE FISHERY OF VIRGINIA. U. S. Fish and Wildlife Service, Res. Rep. 48, 26 pp.

A study of the American shad (Alosa sapidissima) in Chesapeake Bay was made in 1952. Catch and effort records were combined with data obtained from tagging studies conducted at the entrance to Chesapeake Bay, in the James and Potomac Rivers, and at Cove Point (Md.) to obtain population parameters for these areas. These studies were successful except for the results of the tagging at the mouth of the Bay, which data could not be used because of a disproportionate tag recovery-catch ratio between the various areas of Chesapeake Bay. Catch and effort records for previous years were available only for the Potomac River (1944-51). Total population and escapement were determined for each year in which these data were available. It is recommended that the States of Maryland and Virginia establish comparable systems for the collection of catch-and-effort records on the shad so that these basic data will be available for any future study of the Chesapeake Bay fisheries. (Auth. abst.)

1264. Reid, George K. 1957. BIOLOGIC AND HYDROGRAPHIC ADJUSTMENT IN A DISTURBED GULF COAST ESTUARY. Limnol. and Oceanography, Vol. 2, No. 3, July, pp. 198-212.

East Bay, an arm of the Galveston Bay system of Texas, was studied during the summers of 1954, 1955, and 1956. The first study was made with the Bay in its natural state, the second investigation followed the excavation of a pass (Rollover Pass) that permitted considerable interchange between the Gulf of Mexico and East Bay, and the third study was subsequent to partial blocking of the Pass.

Considerable evidence from salinity distribution and fluctuations in population density of the dominant fish and shrimp species suggests a rapid physical and biological reversion toward the natural condition, following the blocking of the Pass. In addition, the presence or absence of certain fish and shrimp forms was correlated with changes in the Bay. (Auth. abst.)

1265. Talling, J. F. 1957. SOME OBSERVATIONS ON THE STRATIFICATION OF LAKE VICTORIA. Limnol. and Oceanography, Vol. 2, No. 3, July, pp. 213-221.

The stratification of temperature and oxygen is described for the open water of Lake Victoria during March-May 1956. The results generally conform to an outline of seasonal changes previously recorded for 1952-54. At the period of strongest stratification a shallow and almost deoxygenated lower layer is marked off by a distinct but deep thermal discontinuity.

The vertical distribution of the planktonic algae during the period of strong thermal stratification is described, with the effects of a later change to more isothermal conditions. Some conspicuous differences between the various species are recorded and classified; thus maximum densities of different species are variously found in upper, middle, and lower layers. These differences are considered to arise mainly from different sinking rates and capacities to withstand conditions in a deoxygenated lower layer. The relation between algal distribution and the photosynthetic zone is briefly discussed. (Auth. abst.)

1266. Pennak, Robert W. 1957. SPECIES COMPOSITION OF LIMNETIC ZOOPLANKTON COMMUNITIES. Limnol. and Oceanography, Vol. 2, No. 3, July, pp. 222-232.

The species composition of limnetic zooplankton communities in 27 Colorado lakes has been determined on the basis of 148 vertical series of plankton-trap samples. Each such series consisted of three or more evenly spaced samples taken from surface to bottom in the limnetic area. Comparable quantitative data for 42 selected lakes in other parts of the world are also considered, such samples having been taken with the plankton trap, pump, Clarke-Bumpus sampler, closing net, etc.

Momentarily, the great majority of Colorado limnetic communities contained one or two species of copepods, one to three species of cladocerans, and three to seven species of rotifers. Comparable data for other small to medium-sized lakes of the world were one to three copepods, two to four

cladocerans, and three to seven rotifers. From a species standpoint, therefore, these limnetic communities are remarkably simple. Depending on the complexities of cyclic and seasonal abundance, however, the individual species making up these communities change from one time of the year to another. The most common and widely distributed North American species are contained in the following genera: Cyclops, Mesocyclops, Diaptomus (Copepoda); Daphnia, Bosmina, Diaphanosoma, Ceriodaphnia, Chydorus (Cladocera); Keratella, Polyarthra, Filinia, Kellicottia, Conochilus, Asplanchna, Synchaeta (Rotatoria).

It is unusual to find more than one species in the same genus in a limnetic community at the same time, at least when ordinary quantitative sampling methods are used. But when two species in the same genus do occur together, one is usually 20 or more times as abundant as the other. These and other phenomena are discussed with particular reference to the "niche" concept.

In spite of the cyclic waxing and waning of populations of individual zooplankton species, the great majority of limnetic communities are characterized at any one time by one numerically dominant species of copepod, one dominant cladoceran, and one dominant rotifer. Thus, adequate sampling in "typical" lakes shows that, on the average, 80 percent of all limnetic copepods belong to one species, 78 percent of all cladocerans belong to one species, and 64 percent of all rotifers to one species. (Auth. abst.)

1267. Benoit, Richard J. 1957. PRELIMINARY OBSERVATIONS ON COBALT AND VITAMIN B_{12} IN FRESH WATER. Limnol. and Oceanography, Vol. 2, No. 3, July, pp. 233-240.

The cobalt, copper, and iron contents of a vertical series of water samples from Linsley Pond are given. Cobalt and iron are higher in the hypolimnion than in the epilimnion, but copper is not. The cobalt and iron content of the seston is estimated to be about equal to the content in normal soils, but the copper content is much higher. Vitamin B_{12} only exists in the water at concentrations lower than the optimum for some algae in culture. The proportion of the total cobalt tied up in vitamin B_{12} in the epilimnion is about 10 percent and about 4 percent or less in the hypolimnion. (Auth. abst.)

1268. Kohn, Alan J. and Philip Helfrich. 1957. PRIMARY ORGANIC PRODUCTIVITY OF A HAWAIIAN CORAL REEF. Limnol. and Oceanography, Vol. 2, No. 3, July, pp. 241-251.

Primary organic productivity was determined by measuring changes in oxygen concentration of sea water flowing over a fringing coral reef at Kapaa, Kauai, Hawaii. Prevalence of a rather strong, unidirectional current facilitated use of this method.

Determinations were made both in summer (July) and winter (November). The reef is autotrophic, as were two previously studied atoll reefs in the Marshall Islands. Gross primary productivity is about 2,900 g $C/m^2/yr$. This is in impressive agreement with results obtained on the atoll reefs, which are the only previous measurements of coral reef productivity.

All three results are considerably higher than determinations of productivity of open ocean waters. The authors attribute this difference to photosynthesis by benthic algae on the coral reef platform. (Auth. abst.)

1269. Carpenter, James H. 1957. THE DETERMINATION OF CALCIUM IN NATURAL WATERS. Limnol. and Oceanography, Vol. 2, No. 3, July, pp. 271-280.

A procedure for the determination of calcium in natural waters is presented which is faster, more precise, and more accurate than those previously described. Photometric weight titration with ethylenediamine-tetraacetate ion in the presence of ammonium purpurate is employed following isolation of the calcium by ion-exchange chromatography. Calcium is separated from magnesium and strontium by the use of acetylacetone as a complexing elutant.

Samples of sea water from the Bahamas region were examined by this procedure, and good agreement was found with reported values determined by the classical triple oxalate procedure. The calcium content is one percent higher than that which would be expected from the accepted calcium-chlorinity ratio. In addition, samples from the Chesapeake Bay indicate that the sea water source for this region has a greater calcium content than would be expected from the accepted calcium-chlorinity ratio for sea water. (Auth. Abst.)

1270. Ryther, J. H. and C. S. Yentsch. 1957. THE ESTIMATION OF PHYTOPLANKTON PRODUCTION IN THE OCEAN FROM CHLOROPHYLL AND LIGHT DATA. Limnol. and Oceanography, Vol. 2, No. 3, July, pp. 281-286.

The relationship was determined between photosynthetic rate at light saturation and chlorophyll content in natural populations and cultures of marine phytoplankton. A mean value of 3.7 g C assimilated/hour/g chlorophyll was obtained from the experimental results and from data present in the literature.

A method is described by means of which organic production beneath a unit of sea surface may be estimated from the chlorophyll content of the water, the total daily solar radiation reaching the sea surface, and the extinction coefficient of visible light in the water column. Production values calculated by this method are compared with values obtained by in situ productivity measurements. (Auth. Abst.)

1271. Barrett, Paul H. 1957. POTASSIUM CONCENTRATIONS IN FERTILIZED TROUT LAKES. Limnol. and Oceanography, Vol. 2, No. 3, July, pp. 287-294.

A series of experiments was performed on a group of six Michigan trout lakes to determine if biological productivity could be increased by the application of commercial fertilizers to the lakes.

Measurements of potassium concentrations in the lakes before and after fertilization indicated that the potassium went into solution in proportion to the amounts of fertilizer added and gradually subsided from epilimnial waters while increasing in hypolimnial waters. Residual effects of fertilization on increased potassium concentrations in both epilimnial and hypolimnial waters were evident for nearly one year following fertilization. Bottom muds showed no marked increases in adsorbed potassium following fertilization. Adsorptive capacities of muds consisting primarily of inorganic materials were considerably greater than organic muds. Intensive phytoplankton blooms occurred following fertilization, but the potassium in the fertilizer probably did not contribute to the blooms because the amounts of potassium put into the lakes were only a small fraction of naturally occurring amounts already present in the lake waters. (Auth. abst.)

1272. Whitney, Lester V. and Richard L. Pierce. 1957. FACTORS CONTROLLING THE INPUT OF ELECTRICAL ENERGY INTO A FISH (CYPRINUS CARPIO L.) IN AN ELECTRICAL FIELD. Limnol. and Oceanography, Vol. 2, No. 2, April, pp. 55-61.

The presence of a fish distorts the electrical field established initially in the water. This distortion, which changes the voltage gradient affecting the fish, and hence the electrical energy-input, is dependent upon the resistivity of the fish as compared to that of the surrounding water. These resistivities depend upon the temperature and chemical content of both water and fish. The criterion of electrical energy-input into the fish may be more important than voltage gradient in the water as an index to fish reactions to electrical fields. A method of measuring fish resistivity is described, and the results of an investigation of the effects of temperature and resistivity on water-to-fish resistivity ratio is presented. The idea is discussed that variation of these conditions may cause changes in energy-input to the fish by factors of 10 or 20 even though voltage gradient in the fish-free water remains constant. (Auth. abst.)

1273. Ragotzkie, Robert A. and Lawrence R. Pomeroy. 1957. LIFE HISTORY OF A DINOFLAGELLATE BLOOM. Limnol. and Oceanography, Vol. 2, No. 2, April, pp. 62-69.

A bloom of Gymnodinium sp. is described in terms of its distribution, growth rate, production, and rate of diffusion. Production measurements on a second bloom of the same organism are also cited. In the center of the first bloom cell concentrations ranged from 1 to 18 million cells per liter. Net production ranged from 2.18 to 13.7 mg C/liter/day. Coefficients of horizontal eddy diffusion as calculated from the observed dinoflagellate distributions were low, ranging from near zero to 350 g/cm/sec. (Auth. abst.)

1274. Eicher, George J., Jr. and George A. Rounsefell. 1957. EFFECTS OF LAKE FERTILIZATION BY VOLCANIC ACTIVITY ON ABUNDANCE OF SALMON. Limnol. and Oceanography, Vol. 2, No. 2, April, pp. 70-76.

Evidence from various sources—tree growth during the past century, chemical composition of waters of various lakes, plankton volumes, size of young salmon migrating seaward—tends to indicate that the fertilization of lake waters in western Alaska by volcanic ash during sporadic eruptions may be an important factor in determining the abundance of sockeye salmon. (Auth. abst.)

1275. Odum, Howard T. 1957. PRIMARY PRODUCTION MEASUREMENTS IN ELEVEN FLORIDA SPRINGS AND A MARINE TURTLE-GRASS COMMUNITY. Limnol. and Oceanography, Vol. 2, No. 2, April, pp. 85-97.

During July and August 1955, primary production measurements were made in 11 Florida spring communities and a marine turtle-grass community in the Florida Keys by means of the diurnal curve method. Diurnal measurements of oxygen and carbon dioxide made at a station downstream from the main springs were used in estimating gross primary production and community photosynthetic quotients. These curves show in detail the course of production hour by hour under various conditions in whole natural communities.

The primary production values obtained ranged from 0.7 grams oxygen/m^2/day in a small, heavily shaded, anaerobic spring on a rainy day to 64 grams oxygen/m^2/day on a sunny day in an aerobic spring where the plant beds trailed at the water surface. A comparison of the chemostatic properties in the springs studied suggests that oxygen, phosphate, nitrate, and carbon-dioxide levels are relatively unimportant in determining the magnitude of primary production in these spring communities. Light as influenced by cloud cover, trees, and water depth is the main controlling factor. Approximate efficiencies found were 0.5 to 10 percent (mean 4 percent) of the visible light energy reaching plant level. Downstream increases in planktonic chlorophyll and oxygen suggested a steady state in 7 km of longitudinal succession in Rainbow Springs River. Net production of benthic algae of 1.5 g/m^2/day was estimated in Orange Springs from the rate of bubble release into funnels placed on the bottom. (Auth. abst.)

1276. Proctor, Vernon W. 1957. STUDIES OF ALGAL ANTIBIOSIS USING HAEMATOCOCCUS AND CHLAMYDOMONAS. Limnol. and Oceanography, Vol. 2, No. 2, April, pp. 125-139.

Five common freshwater algae were grown in the 10 possible 2-membered combinations. No two species grew as well in mixed cultures as they did separately. One combination, Haematococcus-Chlamydomonas, was selected for more detailed study. When grown together in the same container, Haematococcus pluvialis and Chlamydomonas reinhardi were found to be incompatible. The latter invariably dominated the cultures, usually within 3 to 5 days after inoculation. The rate at which Chlamydomonas eliminated Haematococcus was

influenced by a number of factors, the most important being light intensity and nitrogen source. Inhibition of Haematococcus was due to a fat-like extracellular substance that was soluble in alkaline medium, somewhat heat stable, and steam distillable from an acid medium. The inhibitor was produced by Chlamydomonas and liberated upon the death of the cells. It is suggested that the inhibitor is probably a long-chain fatty acid or mixture of such acids.

Eight long-chain, unbranched, saturated, and unsaturated fatty acids of known composition were assayed against six algae. Palmitic was the most toxic saturated acid tested, linoleic the most toxic unsaturated. Haematococcus was the most sensitive alga tested, Chlorella and Scenedesmus the least sensitive. There was a relatively narrow range of concentrations between those causing no inhibition and complete inhibition in the case of Haematococcus.

The results of the present study are compared with those from other investigations of algal antibiosis. (Auth. abst.)

1277. Yentsch, C. S. and J. H. Ryther. 1957. SHORT-TERM VARIATIONS IN PHYTOPLANKTON CHLOROPHYLL AND THEIR SIGNIFICANCE. Limnol. and Oceanography, Vol. 2, No. 2, April, pp. 140-142.

Diurnal fluctuations were observed in the chlorophyll a content of natural phytoplankton populations, with the highest concentrations during the morning and afternoon, low values at midday and at night. This periodicity is similar to the daily rhythm of photosynthesis with which it appears closely related. The rate of synthesis of chlorophyll at optimal light intensity is dependent upon its previous rate of synthesis and concentration in the organisms. All of these factors strongly influence the capacity for photosynthesis at optimal light intensity and are probably the basis for the photosynthetic daily periodicity reported elsewhere. (Auth. abst.)

1278. Clutter, R. I. and L. E. Whitesel. 1956. COLLECTION AND INTERPRETATION OF SOCKEYE SALMON SCALES. Int. Pacific Salmon Fish. Comm., Bull. 9, 159 pp.

This study establishes the methodological basis for the use of scales in the development and implementation of fundamental concepts in the scientific management of Fraser River sockeye salmon. Techniques of scale collection, mounting, and examination are described in detail. A fundamental analysis of scales is made regarding interpretation of life history, including fresh water growth rates and age at maturity. It is shown that sampling procedures for fresh water growth study and age composition study must take into account many variable factors, including: unequal growth among the scales of any given individual sockeye, differences in age composition between sexes, variability of age composition by time during runs, differences in growth and age composition between stocks, changes in growth and age composition from year to year, effects of net selectivity, and variability in availability of size groups among dead fish on spawning grounds. Length frequency and otolith analyses are shown to be useful supplementary methods of determining age composition. (Auth. abst.)

1279. Schaefer, Milner B. and Craig J. Orange. 1956. STUDIES OF THE SEXUAL DEVELOPMENT AND SPAWNING OF YELLOWFIN TUNA (NEOTHUNNUS MACROPTERUS) AND SKIPJACK (KATSUWONUS PELAMIS) IN THREE AREAS OF THE EASTERN PACIFIC OCEAN BY EXAMINATION OF GONADS. Inter-Amer. Tropical Tuna Comm. Bull. Vol. 1, No. 6, pp. 283-320.

Results of investigations on the spawning of these tuna by means of the evidence of development of gonads and on methods of determining rapidly and objectively the state of maturity of the gonads of these species are reported on. Methods of maturity by gross examination; relationships among fish size, gonad weight, and size of ovarian eggs; results of consideration of gonad index data; and sex ratios are covered.

1280. Kirkwood, James B. 1957. A BRIEF STUDY OF THE LEVISA FORK AND RUSSELL FORK OF THE BIG SANDY RIVER. Ky. Dept. of Fish and Wildlife Rsources, Fish. Bull. No. 21, April 1, 15 pp.

The Levisa Fork of the Big Sandy River is located in an area of limited fishing water. Coal mining is the major industry in the Levisa Fork watershed and produces serious pollution problems.

Five hundred and fifty-three fish, weighing approximately 81.4 pounds and representing 44 species were taken from 5 study areas during 3 days of electroseining. The greatest number of specimens were forage-trash species; however, the food fish species produced the greatest weight. It is believed that had it been possible to work the deeper water effectively, game species would have made up a greater percentage of total number and weight. Walleye, common in the late winter and early spring creels from Levisa Fork, and especially Russell Fork, were not captured in these studies.

This study indicates that the Levisa Fork and Russell Fork of the Big Sandy River are supporting desirable fish populations. In addition to the unsampled walleye population, there are indications that smallmouth bass, Kentucky bass, channel catfish, and possibly rock bass are present in sufficient numbers to furnish a moderate sport fishery. Coal mine pollution is a most serious problem in the Levisa and Russell Forks of the Big Sandy River. It is believed that the fish populations could be greatly benefited if it were possible to drastically reduce, in some way, the amount of acid mine water and coal washer waste in these streams.

1281. Gray, E. G. 1956. ABNORMAL COLOR RESPONSES OF THE MINNOW RESULTING FROM INHIBITION OF MOVEMENTS. Nature, Vol. 177, No. 4498, Jan. 14, p. 91.

When a minnow (Phoxinus phoxinus L.) is allowed

to swim freely on an illuminated white or black background, it becomes correspondingly pale or dark in color and remains so indefinitely. However, if the fish is kept stationary by confining it on a white or black background in a glass tube containing running aerated water, its color responses become abnormal. Under these conditions on either a white or a black background the fish fails to become fully white- or black-adapted; it assumes an intermediate tint and maintains this indefinitely. However, if the fish confined on black is subjected to an extraneous stimulus it will suddenly become fully dark in tint and then in the following 15 minutes slowly revert to the intermediate color. No response to an extraneous stimulus in a fish confined on white has been observed; the fish remains an intermediate tint.

The minnow melanophores are under the control of both nerves and pituitary hormones, and the spinal section anterior to the fifteenth vertebra eliminates central nervous control, resulting in very slow background responses effected by hormones. Confinement on black does not interfere with the slow darkening of such a spinal fish, and an extraneous stimulus never results in a momentary darkening. Similarly, when central nervous control is eliminated only from the anterior region of the body by sympathectomy and the fish confined on black, this region slowly becomes fully dark, while the posterior region remains intermediate in color. The abnormal tint caused by confinement appears to be due to interference with the nervous rather than the hormonal chromatic mechanism.

In an unrestricted environment the minnow is an extremely active fish. Confinement thus abolishes continuous somatic motor activities, imposing a learnt inhibition on the central nervous system. It seems probable that this inhibition becomes generalized and affects the brain centers controlling color change. An extraneous stimulus appears to remove temporarily the central inhibition, permitting for a time a normal black-background response.

1282. Gamulin T. and J. Hure. 1956. SPAWNING OF THE SARDINE AT A DEFINITE TIME OF DAY. Nature, Vol. 177, No. 4500, Jan. 28, pp. 193-194.

Spawning by the sardine, Sardina pilchardus, at a specific time of day, namely in the evening, throughout the Adriatic Sea was established by plankton studies. This is an extension of the finding of Ahlstrom for the California sardine, Sardina caerulea.

1283. Lowndes, A. G. 1956. SWIMMING OF FISHES. Nature, Vol. 177, No. 4500, Jan. 28, p. 194.

In an experiment to determine the amount of additional weight a fish can carry it was found that a nursehound (Scyllium catulus) can carry an additional weight amounting to practically 25 percent of its weight in air, while teleosts (with swim-bladders) are practically incapable of carrying anything. Only 95 percent of the weight in air of the nursehound is supported by water; in most teleosts (with swim-bladders), the load carried is about 0.01, or practically the whole of the weight is supported by the water.

1284. Wood, E. J. Ferguson and Peter S. Davis. 1956. IMPORTANCE OF SMALLER PHYTOPLANKTON ELEMENTS. Nature, Vol. 177, No. 4505, March 3, p. 438.

In order to obtain quantitative data on the smaller phytoplankton elements, experiments have recently been conducted in eastern Australia in which 44 gallons of sea-water were pumped into a drum and filtered through a phytoplankton net having 170 meshes per inch. The filtrate was collected and the particulate matter was spun out of 2-litre aliquots using a continuous centrifuge running at 13,000 rev./min.

Both the net fraction and the centrifugate were examined microscopically, using the fluorescence of chlorophyll, to count the photosynthetic organisms and at the same time chlorophyll determinations were made. The chlorophyll content of the centrifugate has been found to be 25-3,000 times as great as that of the net plankton, while the counts of organisms were $10\text{-}10^2$ as high again.

1285. Harding, J. P. and F. W. K. Gervers. 1956. OCCURRENCE OF ACHTHERES PERCARUM NORDMANN IN ENGLISH WATERS. Nature, Vol. 177, No. 4510, April 7, pp. 664-665.

This article records the recent occurrence of the ectoparasite, Achtheres percarum, on perch in the British Isles. It is believed possible that this parasite has been introduced accidentally with perch, pike or pike-perch imported from time to time since 1937 into South England from Holland, Germany and Italy where it is well known.

1286. Smith, J. L. B. 1956. THE STRIPED MARLIN (MAKAIRA AUDAX PHILLIPI) IN SOUTH AFRICA. Nature, Vol. 177, No. 4512, April 21, p. 758.

This article cites the occurrence of a marlin caught in Mossel Bay, South Africa. The fish was 160 pounds in weight, had a total length of 108 inches, and was brilliant purple with numerous conspicuous transverse stripes of faint lavender. This is the most southern record for marlin off South Africa, but is in accord with their presence off New Zealand and South America.

1287. Smith, J. L. B. 1956. PUGNACITY OF MARLINS AND SWORDFISH. Nature, Vol. 178, No. 4541, Nov., p. 1065.

From a wide area of the sea there have been reported occasional incidents illustrating the pugnacity of marlins and swordfish. This has been supported by recent evidence from South African seas, as a result of the Second World War, when a number of ships from the East were torpedoed in the Mozambique Channel. From these vessels quantities of bales of rubber were left floating awash, and from that time many thousands have continually been

stranded, over an enormous stretch of the coast of South and East Africa. It was soon noticed that many bales contained the tips of spears of marlins, and it now appears that the longer a bale remains in the sea the more broken spears it is likely to contain, for those cast ashore in recent times have held as many as four. Most of these residues have been the tips broken near the front of the spear. In one bale was also found the sword of the broadbill swordfish (Xiphias), indicating a similar habit for that species.

1288. Denton, E. J. and F. J. Warren. 1956. VISUAL PIGMENTS OF DEEP-SEA FISH. Nature, Vol. 178, No. 4541, Nov., p. 1059.

Experiments made with the fresh retinae of four species of deep-sea fish caught in the Bay of Biscay showed that the unbleached retinae were golden colored. The golden-colored pigments which were found in high density in all these retinae are suited to make the best use of that fraction of daylight which penetrates deep into oceanic waters. Wald has made the generalization that the retinae of fresh-water fish contain purple pigments (porphyropsins) and those of coastal marine fish contain rose pigments (rhodopsins). Another group may now be added, those of deep-sea fish the retinae of which have principally golden-colored pigments for which the name of chrysopsins or visual golds is suggested.

1289. Southgate, B. A. 1956. SYNTHETIC DETERGENTS AND THE TREATMENT OF WATER AND SEWAGE. Nature, Vol. 178, No. 4525, July 21, pp. 118-119.

During the past few years there has been a growing feeling that household synthetic detergents are among the substances which cause difficulties at sewage works. Moreover, it is known that part of the surface-active agent they contain often passes through a treatment plant and so is discharged with the effluent to a river. It is common knowledge that during the past few years there has been a marked increase in the extent to which foam is formed on polluted rivers, particularly at places where they pass over weirs, and this again is commonly attributed to the presence of the surface-active materials in the water.

It is certain that at many sewage works in Britain, and especially at those using the activated-sludge process, frothing has increased during the past few years to a point at which operation of the plant is made very difficult, and in some cases dangerous, and that this frothing is due to the presence of surface-active constiuents of synthetic detergents in the sewage.

Where an effluent which would seriously interfere with sewage treatment is discharged to the sewers from a factory, it is very often required (legislation being available to enforce this) that it should be pre-treated by the manufacturer to remove the most noxious constituents. It is clear that washing waters containing synthetic detergents cannot be pre-treated by the housewife; but an obvious suggestion is that manufacturers of these substances should endeavor to produce materials which, though satisfactory for washing purposes, would be readily decomposed by the processes, including microbiological processes, commonly used at a sewage works. Thus, any risk there may now be of constituents of detergents persisting in potable water supplies would be removed. Also it is known that surface-active agents in a river may seriously reduce the rate at which atmospheric oxygen dissolves in it; it would be expected, therefore, that they would accentuate the de-oxygenation of a river containing a given amount of polluting matter.

1290. Burden, E. H. W. J. 1956. A CASE OF DDT POISONING IN FISH. Nature, Vol. 178, No. 4532, Sept. 8, pp. 546-547.

As a result of a series of experiments conducted at Khartoum by a private company on the control of Tanytarsus lewsii, a green chironomid, large numbers of fish were killed. The poison used was an emulsifiable oil containing 30 percent DDT and 0.5 percent 'Lissapol'. A spray calculated to give a DDT content of 0.09 ppm. was used. The concentration of DDT at a point 10 miles downstream from where the spraying took place was 0.017 ppm. Eight miles downstream from the area sprayed hundreds of fish were reported dying. Two specimens of fish examined were found to have definitely died of poisoning. The dead fish, a Labea sp., a plant feeder, died within 8 hours of spraying and the Synodontis schall, a carnivorous bottom feeder, had survived for 36 hours. These results lend support to previous work showing that fish are highly sensitive to DDT and that non-fatty animals are more sensitive than fatty ones.

1291. Jones, F. R. Harden. 1956. AN APPARENT REACTION OF FISH TO LINEAR ACCELERATIONS. Nature, Vol. 178, No. 4534, Sept. 22, pp. 642-643.

It has been reported that fish do not appear to react to rectilinear accelerations. However, they have the sense organs to detect such movements; the otolith organs of the thornback ray are sensitive to linear translations in all three planes of space and teleosts take up compensatory positions when subjected to centrifugal force. Some experiments were therefore made to re-examine the reactions of fish to rectilinear accelerations, blinded minnows, goldfish and naturally blind cave characins, Anoptichthys jordani, being used in the preliminary observations. The fish were placed in an enclosed 'Perspex' tank, completely filled with water, and mounted on a rubber-wheeled chassis. They appeared to turn about when the tank was accelerated along a bench by hand.

The reactions of blind goldfish were then studied in a more quantitative manner. A fish was introduced into an enclosed 'Perspex' tank, 60 cm. long, 30 cm. x 15 cm. in section, which was filled with water. The tank was housed in a welded angle-iron chassis fitted with flat rubber-tired wheels running on a 4-m. long railway made from 3/4-inch steel rod firmly attached to sleepers. The chassis was attached to a rope which ran over two pulley wheels

so arranged that the vertical fall of heavy weights would accelerate the tank horizontally along the railway. A range of accelerations and decelerations was covered by varying the weights and the forward run of the tank.

The results showed that blind goldfish would turn about when suddenly stopped going forward, or when suddenly started backwards, but not when started going forwards or when stopped going backwards.

While there is an apparent reaction of blind goldfish to linear accelerations, the results do not show conclusively that the stimulus to which the fish responds is labyrinthine in origin. With these particular fish it was not possible to release the tank when they were at right angles to its line of movement, as they swam for the most part up and down the length of the tank. Nor with the equipment utilized was it possible to detect movement of the water relative to the fish.

1292. Braekkan, Olaf R. 1956. FUNCTION OF THE RED MUSCLE IN FISH. Nature, Vol. 178, No. 4536, Oct., pp. 747-748.

During investigations of the vitamin contents of different organs from the tunny (Thunnus thynnus), samples from the deep-seated red muscle as well as from the neighboring ordinary muscle were analysed for niacin, riboflavin, panthothenic acid, vitamin B_{12} and thiamine. The results revealed an interesting relative distribution. With the exception of niacin, which showed a slightly higher value for ordinary muscle, the red muscle contained several times more of the other B-vitamins than the ordinary muscle.

Chemical analysis revealed that in most fishes the red muscle has a much higher fat-content than the neighboring ordinary muscle; the values of the samples from mackerel, herring and halibut were about 27-29 percent.

If we further consider the relatively frequent high fat-contents in the red muscle, and the fact that the white muscle contains no myoglobin and low contents of the B-vitamins except for niacin, it is likely that the main purpose of the red muscle is not muscular work, but that it functions as an organ.

Finally, consider the presence of the red muscle in relation to the normal activities of the species. The anatomical situation of the red muscle prevents it taking part in the main muscular work. Further, of the species investigated, the tunny, as a very active and fast-swimming fish, has the highest proportion of red muscle. Next come mackerel and herring, which also move rapidly in shoals. On the other hand, halibut, as a flat fish, has less and a paler red muscle. Further considerations along these lines give the same general relation between activity and the extension and pigmentation of the red muscle in different species.

1293. Hoar, William S. 1956. PHOTOPERIODISM AND THERMAL RESISTANCE OF GOLDFISH. Nature, Vol. 178, No. 4529, Aug. 18, pp. 364-365.

Two groups of goldfish with a mean weight of 14.2 gm. were subjected to different photopheriods. The first group received 8 hour illumination (70 ft. candles at the water surface) and 16 hours darkness, while the second group received 16 hour illumination (same intensity) alternating with 8 hour darkness. The first situation corresponded to the hours of sunlight in winter, and the second to the sunlight period of summer. Temperatures varied from 18° to 20° C. in the room but were the same in all tanks. The diet was pablum and shrimp meal.

The thermal resistance of the two groups was compared after 40 days and after 50 days. In tests of thermal resistance, the two groups, marked by distinctive fin clips, were placed together in a lethal-temperature bath. The temperature in the cold bath fell from about 4° C. to 1° C.; that of the warm bath was about 36.5° C.

In the heat test, 25 percent of the short-day fish were dead at 31 minutes, while the same percentage of long-day fish survived until 41 minutes—a difference of 10 minutes in the 25 percent lethal times. The temperature of the lethal bath at 41 minutes was 36.5° C.; the initial temperature of this bath was 34.5° C. In the cold test, carried out at the same time, 25 percent of the sample of short-day fish were dead at 198 minutes, while the same percentage of long-day fish had died at 102 minutes. The temperature of the bath at 198 minutes was 1.2° C.

The short-day period fish, winter fish, are consistently more resistant to cold and less resistant to heat, whereas the reverse is true of the long-day period fish, summer fish.

1294. Havelka, J. and M. Effenberger. 1957. PŘÍZNAKY PŘI OTRAVĚ RYB FENOLY (Symptoms in Phenol Poisoning of Fish). Sborník Československé Akademie Zemědělských Věd, Ročník 2 (XXX), Číslo 5, pp. 421-424.

In acute and chronic phenol poisoning of fish there is no bleeding from the gills. The fish die of symptoms which are usual in nerve poisoning. Suffocation occurs with the same symptoms as for a lack of oxygen—too much blood in the gills, blood coagulation in the heart cavity. These findings suffice to prove phenol poisoning, especially if phenols are found in the water by chemical analysis or by the smell of the fish. (Auth. summ.)

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